This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

UC-NRLF
B 3 965 787

~~AGRIC. DEPT.~~

ENTOMOLOGY
LIBRARY

AGRICULTURAL LIBRARY. UNIVERSITY OF CALIFORNIA.

Published monthly by the University of the State of New York

BULLETIN 72 DECEMBER 1903

New York State Museum

FREDERICK J. H. MERRILL Director
EPHRAIM PORTER FELT State Entomologist

Bulletin 72

ENTOMOLOGY 19

GRAPEVINE ROOT WORM

EPHRAIM PORTER FELT D.Sc.

	PAGE
Preface	3
Introduction	5
Area infested	6
Signs of insect's presence	6
A native species	7
Allies	8
Present conditions in Ohio	9
Early history	11
Description	13
Life history	15
Habits of the beetle	15
Eggs	19
Habits of the grubs or larvae	23
Pupa	25
Experimental work in 1903	26
Record of cage experiments	27
Insects taken by beetle catcher	29
Food plants	30
Varieties affected	30
Grapeberry moth	31
Natural enemies	32
Remedial measures	33
Destroying the pupae	33
Collecting beetles	34
Arsenical poisons	39
Destruction of eggs	44
Pulverizing the soil and mounding	45
Carbon bisulfid	45
Kerosene emulsion	46
Crude petroleum	46
Calcium carbid	46
Recommendations	47
Bibliography	47
Explanation of plates	50
Index	53
Plates 1–6	facing 52

ALBANY
UNIVERSITY OF THE STATE OF NEW YORK
1903

Mel12m-S3-1500

Price 20 cents

~~Agric. Dept.~~

ENTOMOLOGY
LIBRARY

Agric. Dept

AGRICULTURAL LIBRARY. UNIVERSITY OF CALIFORNIA

BULLETIN 72 *Published monthly by the* University of the State of New York DECEMBER 1903

New York State Museum

FREDERICK J. H. MERRILL Director
EPHRAIM PORTER FELT State Entomologist

Bulletin 72

ENTOMOLOGY 19

GRAPEVINE ROOT WORM

EPHRAIM PORTER FELT D.Sc.

	PAGE
Preface	3
Introduction	5
Area infested	6
Signs of insect's presence	6
A native species	7
Allies	8
Present conditions in Ohio	9
Early history	11
Description	13
Life history	15
Habits of the beetle	15
Eggs	19
Habits of the grubs or larvae	23
Pupa	25
Experimental work in 1903	26
Record of cage experiments	27
Insects taken by beetle catcher	29
Food plants	30
Varieties affected	30
Grapeberry moth	31
Natural enemies	32
Remedial measures	33
Destroying the pupae	33
Collecting beetles	34
Arsenical poisons	39
Destruction of eggs	44
Pulverizing the soil and mounding	45
Carbon bisulfid	45
Kerosene emulsion	46
Crude petroleum	46
Calcium carbid	46
Recommendations	47
Bibliography	47
Explanation of plates	50
Index	53
Plates 1-6	free 52

ALBANY
UNIVERSITY OF THE STATE OF NEW YORK
1903

Mel12m-S3-2500

Price 20 cents

ENTOMOLOGY LIBRARY

University of the State of New York

REGENTS

With years of election

1892 WILLIAM CROSWELL DOANE D.D. LL.D. *Chancellor*, Albany
1878 WHITELAW REID M.A. LL.D. *Vice Chancellor*, New York
1877 CHAUNCEY M. DEPEW LL.D. - - - - New York
1877 CHARLES E. FITCH LL.B. M.A. L.H.D. - Rochester
1881 WILLIAM H. WATSON M.A. M.D. LL.D. - Utica
1881 HENRY E. TURNER LL.D. - - - - Lowville
1883 ST CLAIR MCKELWAY M.A. L.H.D. LL.D. D.C.L. Brooklyn
1885 DANIEL BEACH Ph.D. LL.D. - - - Watkins
1890 PLINY T. SEXTON LL.D. - - - - Palmyra
1890 T. GUILFORD SMITH M.A. C.E. LL.D. - Buffalo
1893 LEWIS A. STIMSON B.A. LL.D. M.D. - - New York
1895 ALBERT VANDER VEER M.A. Ph.D. M.D. - Albany
1895 CHARLES R. SKINNER M.A. LL.D. Superintendent of Public Instruction, ex officio
1897 CHESTER S. LORD M.A. LL.D. - - - Brooklyn
1900 THOMAS A. HENDRICK M.A. LL.D. - - Rochester
1901 BENJAMIN B. ODELL JR LL.D. Governor, ex officio
1901 ROBERT C. PRUYN M.A. - - - - Albany
1902 WILLIAM NOTTINGHAM M.A. Ph.D. LL.D. - Syracuse
1903 FRANK W. HIGGINS Lieutenant Governor, ex officio
1903 JOHN F. O'BRIEN Secretary of State, ex officio
1903 CHARLES A. GARDINER LL.B. M.A. Ph.D. LL.D. New York
1903 CHARLES S. FRANCIS B.S. - - - - Troy

One vacancy

SECRETARY

Elected by Regents

1900 JAMES RUSSELL PARSONS JR M.A. LL.D.

DIRECTORS OF DEPARTMENTS

1888 MELVIL DEWEY M.A. LL.D. *State Library and Home Education*
1890 JAMES RUSSELL PARSONS JR M.A. LL.D. *Administrative, College and High School Dep'ts*
1890 FREDERICK J. H. MERRILL Ph.D. *State Museum*

University of the State of New York

New York State Museum

FREDERICK J. H. MERRILL Director
EPHRAIM PORTER FELT State Entomologist

Bulletin 72

ENTOMOLOGY 19

GRAPEVINE ROOT WORM

ENTOMOLOGY LIBRARY

PREFACE

The grapevine root worm has proved itself such a destructive enemy of vineyards in the Chautauqua grape belt, and so little success has attended efforts to control it, that it was deemed advisable in 1902 to undertake an investigation of this insect. The work of last year was embodied in Museum bulletin 59, and the material additions to our knowledge of this pest, gained in 1903, have rendered it advisable to issue an extended and revised edition of our previous publication, because the subject is of such vital importance that our growers should have all available information at their disposal. Many valuable facts have been ascertained during the last two seasons; and the additional data gained in 1903 demonstrate the value of timely cultivation and prove that collecting the beetles is practical, the most reliable and probably the most economical method of controlling this very serious enemy of the vine.

Through the courtesy of the Hon. C. A. Wieting, commissioner of agriculture, the entomologist has been able to avail himself of the services of nursery inspector J. Jay Barden who has cooperated with the writer very efficiently, and most of the field investigations were carried on with the assistance of this gentleman. Acknowledgment is due Mr D. K. Falvay of Westfield, who kindly placed a portion of his excellent vineyard at our disposal and cooperated with us most efficiently, thereby not only benefiting himself but aiding materially in demonstrating a practical

271190

method of controlling this pest, after it had become well established in a vineyard. The breeding cage and other office experiments have been conducted under the writer's direction by his first assistant, Mr C. M. Walker, aided by the second assistant, Mr D. B. Young. The author is also under obligations to Prof. Percy J. Parrott, entomologist of the Ohio Agricultural Experiment Station, and Prof. A. F. Burgess, chief San José scale inspector of Ohio, who kindly accompanied him in his investigation of conditions in that state in 1902 and supplied additional information in 1903.

E. P. FELT

Albany N. Y. September 1903

GRAVEVINE ROOT WORM

Fidia viticida Walsh

Ord. *Coleoptera* Fam. *Chrysomelidae*

INTRODUCTION

The control of this pest in the Chautauqua grape belt is a serious problem which we have attempted to solve. The insect has, in recent years, caused enormous damages in the Ohio grape belt and now occurs in large numbers in Portland, Westfield and Ripley and has obtained a foothold over a large area. Messrs Walter Northrop and F. A. Morehouse estimated in the spring of 1902 that over 80 acres of magnificent vineyards had been destroyed or ruined by the pest in the vicinity of Ripley, and our investigations at the present time show that the area of severe injury and damage is constantly increasing, and is liable to much greater extension in the next few years. We consider this insect a much more serious enemy of the vineyard than the well known grapevine leaf hopper or white fly,[1] the work of which was so apparent and destructive in 1902 and the preceding two or three years. This leaf hopper undoubtedly causes much mischief, but, as its operations are confined to the leaves, the amount of damage is easily seen and, when necessary, steps may be taken to control it. The root worm on the other hand inflicts its most serious injuries under ground, where its operations can not be readily observed, and in a great many instances a vine or an entire vineyard is entirely ruined before the grower observes any trouble. This pest only requires two or three years to ruin a vineyard; and this, in connection with the secrecy of its work and the feeding of the grubs on the large roots, where a small amount of girdling is fatal, renders it a most dangerous enemy. Worst of all, this insect exhibits a decided preference for the more thrifty vineyards and is found most abundantly on or beneath the most vigorous vines. We believe that 15 or 20 grubs about a vine or as many beetles on its foliage are sufficient to warrant the adoption of vigorous measures for the suppression of the pest, though we are well aware that many more are fre-

[1]Typhlocyba comes var. vitis Harris

quently seen in a vineyard still alive. The marvelous prolificacy of the insect, as demonstrated by our studies, justifies the belief that even a relatively small number are sufficient to threaten the welfare of a vineyard.

The season of 1902 was unusually favorable to vine growth, and the same is true of the past summer, a condition for which the grower should be thankful, since it has enabled the vines to withstand insect attacks more successfully.

Area infested. Ripley appears to be the original center of this insect's most destructive work, though it has been found generally present in small numbers in many vineyards where little evidence of serious injury occurs. The pest very probably made its way into the Chautauqua grape belt from Ohio; and our investigations in 1903 show that it is present in greater or less numbers from the state line as far east as Sheridan, if not farther and from the lake shore to the top of the adjacent hills. We have also found it in small numbers in Hudson river valley vineyards at Highland and Milton.

Signs of the insect's presence. The more destructive work of this pest is somewhat difficult to detect, and is usually indicated by a weakness in vines and a marked decrease in the amount of new wood. The indications of the presence of the beetles are so characteristic that there should be little trouble in locating them. The peculiar chainlike eaten areas, represented in numbers on plate 6, are very characteristic of the insect and differ so much from the work of most other pests that no difficulty should be experienced in identifying it. The beetles show a decided preference for leafy vines, and the general appearance of some very badly eaten ones is shown on plate 5. The feeding of the beetle is usually the first visible indication of its presence and is not accompanied at the outset by signs of material injury. As the attack progresses and the work on the roots becomes more injurious, the development of the fruit is severely checked and the bunches may be less than half their normal size. The growth of wood is also much reduced, and vines which are very badly infested may die in midsummer. Cases were brought to the writer's attention where plants which had grown over 6 feet of wood the preceding summer, wilted in June and died. Infested vines as a general thing become less thrifty, develop less and

less wood yearly till finally there is not enough to tie up. A portion of a vineyard very seriously injured and where there is not wood enough to tie up is represented on plate 3. This condition rapidly becomes worse, and soon, usually in two or three years after the insect has been present in numbers, there is no wood, and the vines are simply a small mass of foliage resting on an old stump as represented on plate 4.

The depredations of this pest are much more serious and usually first apparent on light sandy or poor soils, and in particular on gravelly knolls, though we have found the beetles much more abundant in rich, low, though not wet hollows. The insects seem to thrive under such conditions, and a deficient growth should lead to immediate investigation. Vines on rich clay soils in our experience are less injured by this pest, due probably to their greater resistant powers; and this appears to be the case in Ohio. It should be remembered that vineyards on heavy clay lands are not exempt from attack and should be closely watched and, if necessary, active measures employed to keep the number of beetles below the danger point.

The roots also afford a clue to the identity of the depredator. The young grubs eat away the small feeding branches, while the larger individuals gnaw the bark, particularly from the underside of the larger roots. They frequently eat away long strips, as represented on plate 1, figure 5, though occasionally a single grub may work along a somewhat sinuous path.

A native species. This serious pest of the vineyards is not, like many of the forms so injurious to agriculturists, an imported insect. It has long been known to occur in this country and its work on wild grapevines was observed before its depredations attracted notice in our vineyards. This insect may develop into a general pest of the grape and perhaps in time come to be as well known as the very destructive Colorado potato beetle, which is familiar to almost every farmer. It is very probable that this grape enemy was able to exist only in relatively small numbers on wild vines and hence was rarely very injurious. It seems to have developed a great fondness for some of our cultivated varieties, and the growing of these in large areas has enabled it to increase to an almost unparalleled degree. This may perhaps be cited as one of the cases

where the devotion of extensive tracts to one crop has resulted after years in a species formerly harmless becoming very destructive.

It is interesting to note in this connection that the insect is by no means new to New York State. There are examples of the beetles in the private collection of the late J. A. Lintner, which were taken in Schenectady in 1880 and on Virginia creeper at Albany in 1882, and yet so far as known there is no record of the species proving destructive in this section. The writer also met with the insect at Albany in considerable numbers on Virginia creeper in 1901, and, though he has frequently visited vineyards in the vicinity, no signs of the insect were observed. It is very possible that the death of vines in early years here and there may have been caused by this beetle and attributed by growers to other agencies, as was the case before Professor Webster discovered the identity of the depredator in Ohio.

Allies. This species belongs to the large family of leaf-eating beetles, known as the Chrysomelidae, a group which comprises some of our most destructive insects. To it belongs the notorious elm leaf beetle,[1] a species which has destroyed thousands of magnificient shade trees in the Hudson river valley, and may in a few years become a most serious enemy to elms in other sections of the State. The two asparagus beetles,[2] are well known enemies to the grower of this succulent vegetable. The familiar yellow and black striped squash bug[3] is another ally of this destructive grape pest, which is sometimes aided in its deadly work by the steely or grapevine flea beetle,[4] a species which has caused great injury in some New York vineyards during recent years. A number of other related forms, nearly as injurious as those named, could be easily listed. These destructive allies are mentioned in this connection simply that the grape grower may have some idea of what related species can do; and, while this pest may not prove so generally injurious as any of these, it has already demonstrated its ability to cause much mischief. We see no reason at present for thinking that the history of this

[1] Galerucella luteola Müll.
[2] Crioceris asparagi Linn. and C. 12-punctata Linn.
[3] Diabrotica vittata Fabr.
[4] Haltica chalybea Illg.

insect in Ohio may not be duplicated in the Chautauqua grape belt, and perhaps in other sections of the State where this fruit is largely grown.

Present conditions in Ohio. The destructive work of this serious pest has been known in Ohio for some years. It was first brought to the attention of Professor Webster in 1893. The similarity of conditions existing between the Ohio grape belt and the Chautauqua region led the entomologist to believe that valuable data could be secured by personally investigating the present status of the insect in Ohio. This interesting section was visited about the middle of September 1902, and much valuable information secured through the kindly cooperation of Prof. P. J. Parrott, entomologist of the Ohio Agricultural Experiment Station, Prof. A. F. Burgess, chief San José scale inspector, and a number of prominent growers. The local knowledge of conditions possessed by the two gentlemen named enabled us to visit the sections of most importance with very little loss of time. Some very precise and significant statements were obtained in 1902 from Mr T. S. Clymonts of Cleveland O., who is not only a grower but also a dealer and one who undoubtedly has as good a general knowledge of local conditions as any one in that section. He stated that in the Ohio belt, extending east and west of Cleveland, from Painesville to Avon and reaching back 5 miles from the lake, there had been a reduction in shipments of fully two thirds during recent years. In 1894, 2000 carloads of grapes were shipped from that section. This was reduced in 1900 to 900 and in 1901 to 600. Mr Clymonts estimated the output for 1902 at not over 500 carloads.

He stated that this reduction is due to various causes, the principal ones being the ravages of the grape root worm, the destruction caused by rot, and the prevailing low prices. He attributed fully one third of the entire reduction to the beetles' work and instanced a number of cases where vineyards of considerable size had been killed by the operations of this pest. He mentioned one vineyard of 60 acres, another of 25 acres, and stated that innumerable small pieces had been destroyed by the work of this insect, and added that the yield of one 60 acre vineyard had been cut from 10–12 carloads to 35–40 tons by its

operations. Mr Clymonts's observations led him to think that as a rule the younger vineyards, specially those planted in the last 10 or 12 years, suffered most, and that the old ones escaped with comparatively little harm. The most destructive work observed by him had been on sandy soil, or on ridges in other pieces. He also stated that vines set in an infested vineyard to fill vacancies do not thrive and are usually killed by the insect. A recent communication, Aug. 27, 1903, states that nothing has developed the present year to make it advisable to modify any of the above statements.

Mr J. W. Maxwell of Euclid stated in 1902 that 50% of the vineyards were dead in that section, and that in his opinion a large proportion of them died as a result of the operations of this insect. His crop of grapes in a large vineyard was reduced fully one fourth, the most of which he attributed to this pest. He stated that the Wordens and Brightons were killed first, while the Concords and Catawbas were not so badly injured. He also adds, in a letter dated Aug. 29, 1903, that renewing a vineyard with Niagara vines seems to be quite a success, since 800 roots set two years ago in vacancies all lived and have done well. We hope this will continue to be the case, but in the writer's opinion these recently set vines have just reached a very attractive condition, so far as the beetle is concerned, and he is afraid that injury may result in a year or two.

Mr W. H. Slade of East Cleveland estimated in 1902 that one fourth of the vineyards in that section had been destroyed by this insect pest. and according to his observations the Wordens and Catawbas suffered more than the Concords. The most serious damage in his experience was met with on the lighter soil of knolls.

Mr W. W. Dille of Nottingham was of the opinion in 1902 that there has been a decrease in recent years of 40% in the area devoted to grapes. He attributed this shrinkage about equally to the rot, which had been very prevalent, to the operations of the grape root worm, and prevailing low prices. He stated that the insect injuries had been limited mostly to the bluff and to vineyards in the near vicinity of the lake shore, those back and just under the bluff escaping with comparatively little damage. He considers the Concord as one of the most resistant varieties.

A number of other growers were interviewed in 1902, and some disparity of opinion naturally prevailed. It will be seen, however, that there are a number of well informed men in that section who attribute very serious injuries to this insect; and, while the estimates of some may be excessive, there can be no doubt that the pest has caused very serious losses. The season of 1902 was unfavorable for observing the work of this pest because the repeated rains enabled the vines to sustain much greater injury than they would in times when there was less moisture. These conditions prevented the making of personal observations on the destructiveness of the insect, and most of our data relating to this had to be obtained from the evidence of others.

Considerable attention was also given to the various remedial measures employed by different growers, and some diversity of opinion existed. A number had sprayed their vines with arsenate of lead and also with bordeaux mixture. A few were of the opinion that spraying with arsenate of lead is a very efficient check on the increase of the insect, while others believed that it was of comparatively little value. Mr T. S. Clymonts stated that spraying with the bordeaux mixture alone affords some protection, as the beetles migrate to untreated vines. This subject will be discussed more at length under "Remedial measures." Most of the growers agree that thorough cultivation assists the vines greatly in resisting the depredations of the grubs. Those on whose premises carbon bisulfid was used were not favorably impressed with the substance. They state that in any event the cost of application is excessive considering the prevailing low prices for grapes. Considerable injury was caused in certain vineyards by carbon bisulfid, and it is very doubtful if this measure can be used to advantage.

Early history. This insect was first brought to notice in 1866 when specimens were sent from Kentucky to Mr B. D. Walsh, afterward state entomologist of Illinois. This gentleman stated at the time that he had taken the beetle in small numbers in both north and south Illinois, and later in the same year described the species. He also received the insect the following year from St Louis and Bluffton Mo., where the adults were said to be eating both foliage and fruit. Prof. C. V. Riley, in his first

report on the *Injurious and Beneficial Insects of Missouri,* characterizes this species as one of the worst foes to the grapevine in Missouri. This condemnation was based solely on the operations of the beetle on the leaves, an injury which is now regarded as of little importance compared with the work on the roots. Professor Riley received specimens from Bunker Hill Ill. in 1870, and in 1873 Mr G. R. Crotch described the insect[1] and gave its recorded distribution as the Middle and Southern states. The identity of the species described by Mr Crotch and this insect was pointed out by Dr Horn in 1892, when he recorded its distribution as the "Middle states to Dakota, Florida and Texas." He also states that the insect described by Lefevre[2] belongs to this species. This pest was received from the vicinity of Iowa City Ia. by Prof. H. F. Wickham in 1888, and Professor Riley has recorded this form and an allied one[3] as injuring grape leaves at Vineland Ark.

Nothing further was known regarding this species till 1893, when specimens were sent to Prof. F. M. Webster, then of the Ohio Agricultural Experiment Station, who made an exhaustive study of the insect and published a detailed account of his investigations in 1895.

Injuries by this insect in the state of Arkansas were recorded by Prof. J. T. Stinson in 1896, and in the same year Professor Webster notes a decrease in the numbers of the pest in Ohio vineyards and attributes it as possibly due to the efficient work of two egg parasites and a small mite.[4] The following year Messrs Webster and Mally reported, as a result of a series of experiments, that tobacco dust and kainit were practically ineffective against this insect, and two years later these gentlemen record the unusual abundance of the pest in Ohio vineyards, and state that serious injuries occurred at Bloomington Ill. The presence of this beetle in destructive numbers in the Chautauqua grape belt was recorded by Prof. M. V. Slingerland in 1900, who at that time published a general compiled account of the insect. Dr J. B. Smith, in his *Catalog of the Insects of New*

[1] Fidia murina Crotch
[2] Fidia lurida Lefevre
[3] Fidia longipes Melsh
[4] Heteropus ventricosus Newport

Jersey states that this species occurs throughout New Jersey on the grape and Virginia creeper or Ampelopsis, and he also records it from Staten Island. A brief note published by Dr L. O. Howard in 1901 states that the depredations of this insect at Bloomington Ill. continue unabated and severe damage to vineyards is recorded. The writer, in the early spring of 1902, published a brief notice of the extent of the injuries in the Chautauqua grape belt with a summary of the life history of the pest and outlined a series of experiments for that year, which are reported on in detail in this bulletin together with the results obtained in 1903.

DESCRIPTION

The perfect insect is a small, brown, rather robust beetle about $\frac{1}{4}$ inch in length and rather densely covered with short grayish white hairs. It may be recognized by aid of plate 1, figure 1.

The egg is about $\frac{1}{25}$ inch in length with a transverse diameter about one fourth as great. Form, nearly cylindric, tapering a trifle at each end. The shell is flexible, and, when a number of eggs are crowded in a small space, they may become somewhat distorted. The eggs are white when first deposited, but soon assume a yellowish cast. On the fourth day a narrow semitransparent band appears near each end. The eggs of the clusters normally have a somewhat concentric arrangement, and range in number from 1 to 125. Several clusters are represented on plate 1, figure 3.

The young larva is creamy white, about $\frac{1}{17}$ inch in length and tapers somewhat posteriorly. The head is a pale, yellowish color with the mouth parts ranging from light to dark brown, the sutures and tips of the mandibles having the most color. The head is somewhat flattened, bilobed and with the posterior angles rounded. The mandibles are distinctly toothed. The body is slightly smaller than the head, convoluted and distinctly segmented. Each segment bears a transverse row of small tubercles, from each of which a long hair arises. The spiracles, or breathing pores, are darker than the body and usually light yellow.

The nearly full grown grub resembles the newly hatched individuals very much in general form and color. It is then

about $\frac{5}{8}$ inch in length, with a yellowish brown head and the mouth parts and adjacent sutures dark brown or nearly black. The body has a greater transverse diameter than the head, is distinctly segmented and bears numerous irregular transverse rows of small setae, which are relatively much shorter than in recently hatched individuals. The spiracles are well marked and range in color from yellowish brown to light brown. The general appearance of the grub is shown on plate 1, figure 4. Its white color and curled form suggest the common white grub, in spite of its much smaller size.

The pupa ranges in length from about $\frac{1}{4}$ to $\frac{1}{3}$ inch and its general features are represented on plate 1, figure 6. It may be recognized by its white color with a pinkish tint about the head, thorax and posterior extremity. The head is adorned with a semicircular row of four spines, the middle two being larger and nearly erect, the others smaller and more divergent. There is a similar row near the anterior margin of the thorax, though the curve is not so pronounced as on the head. Just behind this latter row there is a cluster of four smaller, nearly erect spines placed in pairs, the posterior being more widely separated. The anterior femora is armed at its tip with a stout hook, while above and at one side is a single straight, hair-tipped spine with sometimes a second one below. The posterior femora is likewise armed with a stout hook and with two hair-tipped spines. At the posterior extremity, there are two flattened, stout spines projecting dorsally. The penultimate segment is armed with a pair of small, median spines with a smaller pair of closely placed ones on each side, and on the antepenultimate there is a median cluster of four closely placed, hair-tipped spines, the inner two being smaller. There is also a lateral spine on each side [fig. 1]. The other segments are each provided with a single transverse row of minute, short bristles, and on the scutellum there is a median pair of larger ones.

FIG. 1 Posterior segments of pupa (original)

This pupa may be known by its general form and coloration, and by the peculiar arrangement of the spines at its posterior *extremity*, as shown in the figure.

LIFE HISTORY

The life history of this insect may be summarized as follows:

The winter is passed by the nearly full grown grubs in oval cells in the soil, and so far as our observations go the great majority of them occur from 10 to 12 inches below the surface and mostly near or in the subsoil. On the approach of warm weather, the grubs work upward, probably early in May in most years, and are then mostly within a few inches of the surface and usually within 15 to 24 inches of the stem of the grapevine, though some, and occasionally large numbers, may be found near the middle of the row. Usually very little feeding is done in the spring. The transformation to the pupa occurs in normal seasons from about June 1 to 20, the adults issuing approximately two weeks later or from about June 20 onward. The great majority of the beetles appear the last of June or early in July, though some do not emerge till the last of the month and in rare instances much later. A pupa was met with Aug. 15, 1902, and the adults have been found in New York vineyards as late as September and even in October. The latter are probably from belated larvae. The eggs are mostly laid in July and August under the loose bark of last year's wood and require a period of about two weeks to hatch. The young grubs make no attempt to crawl down but drop, and working under the loose soil make their way to the small feeding roots, where under favorable conditions they grow rapidly and after increasing considerably in size attack the larger roots, eating away long strips of the bark [pl. 1, fig. 5]. The latter, when a large number of grubs are present, may rest simply on a bed of borings. Many of the grubs attain nearly full size the latter part of August or early in September. Late in the fall the larvae descend to considerable depths, as previously noted, construct their oval cells and pass the winter within them.

Habits of the beetle. The habits of the beetle are of special interest because it is practicable to collect these insects and thus in a large measure prevent egg-laying and consequent damage from the grubs. Professor Webster states that the beetles normally begin to appear in northern Ohio about June 20. This agrees closely with our observations. The season of 1902 was remarkably late, and very few beetles were observed previous to

July 2, while in 1903 a few were taken June 19. Their first appearance was on light soil, and the insects did not begin to emerge in numbers on heavy land till nearly a week later. Our cage experiments [*see* table on p. 27] show that over 92% of the beetles appeared within two weeks after the first were taken, and practically none after July 21. In other words, out of 506 bred from under two vines, 477 emerged by July 21. The issuing of the insects is undoubtedly considerably modified by temperature, as demonstrated by the beetles appearing in unusually large numbers on the 26th, which was a bright, warm day. The time of appearance and the fact that a large proportion of the insects issue from the ground within two weeks are of much importance, if anything is to be done by collecting the insects. The beetles appear to emerge and remain on the foliage, particularly around buds, several days before they feed to any extent. Breeding cage experiments have fixed this period at from one to four days. Two beetles which actually emerged under observation refused food till the fourth day, and it is very probable that this period is nearly the normal time between the emergence of the beetles and feeding. A considerable number may be found before any feeding has taken place, as is evidenced by Mr Barden taking 12 from a vine which bore practically no marks of their eating. The insects may be found in a field over an extended period, which is not surprising in view of the fact that a beetle may live over nine weeks, as demonstrated by us this year. Some were observed by Mr T. T. Neill Sep. 4, 1902, in a vineyard at Fredonia, and Mr F. A. Morehouse states that he met with individuals in October 1902.

Oviposition does not occur till some days after the appearance of the perfect insects, and according to breeding cage observations this period may range from 10 to 17 days. Our breeding cage experiments also indicate that the insect may feed from 6 to 13 days before eggs are deposited. This period was carefully ascertained by isolating a series of males and females and providing them with as nearly natural conditions as possible. Both of these periods are much longer than normal, since eggs were found by Mr Barden in the Northrop vineyard July 9, 1902, where beetles were present in very small numbers on the 2d. This allows a maximum of only seven days between the appear-

ance of the earliest insects and the laying of eggs; and, if, as can hardly be questioned, the insects remain without taking food for two or three days, then the time of feeding before the deposition of eggs can hardly exceed an equal period. The first beetles were observed in 1903 on June 19, and a few contained nearly developed eggs July 2, at which time it was very warm and there were many pairing, and eggs were deposited a day or two later, making about two weeks between the appearance of the first beetles and the deposition of eggs. This period is a little longer than was the case in 1902, but even then does not equal our breeding cage records. This matter is of considerable importance because it shows how quickly collecting must be done or poisons must act in order to prevent the deposition of many eggs.

The feeding of the beetles occurs almost entirely on the upper surface of the leaves and, as described by Professor Webster, "is done by gathering a quantity of the substance of the leaf in the mandibles and jerking the head upwards, after which the body is moved a step forward and another mouthful of food secured as before. After securing a few mouthfuls in this way, they move to another place and begin again, thus eating out numerous chainlike rows of silk net" as shown on plates 5 and 6. "The insects usually eat only to the lower epidermis on foliage having a velvety undersurface, but on others they eat entirely through the leaf." The beetles are shy and retiring by nature and feed largely in sheltered places or among the growing tips, both difficult places to hit with a spray. A favorite retreat of the insects is among the tendrils clinging to the top wire. Many of those feeding on the leaves are easily frightened, and when alarmed usually fold up their legs and fall to the ground, where they remain quiet till all danger appears to have passed. They can spring readily either with the legs or when inverted by suddenly opening the wing covers and projecting themselves from the hand or other support. The beetles on the canes, however, are not so easily disturbed. They can frequently be picked from the vine, and it requires repeated jarring to dislodge all. This is of considerable importance when collecting beetles with any machine, and the persistence with which some hang to the wood is an objection to this method of

controlling the insect. They are, however, much more easily jarred from the vines on warm days.

The tendency of this species to remain in a locality for a time, at least, is well shown in a certain vineyard at Ripley. It had suffered very severely in earlier years from the depredations of this pest and a portion of it was uprooted in the spring of 1902. A small area was allowed to remain in the hope that it could be brought back to a normal condition. A few rows next to the uprooted area were fed on to a very great extent by the beetles, which had evidently emerged from the adjacent soil and made their way to the nearest vines, where they were content to remain and feed. The extensive injury inflicted on these vines is well illustrated on plate 5, which shows how badly many of the leaves were riddled. A curious fact in connection with the abundance of the beetles on these small vines is that few or no eggs could be found, probably due to the small amount of wood. Observations have shown that while there is undoubtedly a connection between the amount of feeding and the number of eggs laid, such is not necessarily true of the feeding and the number of eggs or grubs on particular vines. This is a matter of some importance because many growers are inclined to estimate the number of grubs at the roots by the amount of feeding on the foliage, whereas it frequently occurs that more grubs are found under vines with foliage but little eaten than under those which bear evidence of excessive feeding. This tendency of the insects to remain in a locality for a time is favorable to local control, since it gives an opportunity to destroy them by collecting before there is much dispersion. Such opportunities should be embraced promptly, because it is well known that at times the beetles fly to a considerable extent. Mr Schonfeldt has called the writer's attention to an instance where numbers of the insects suddenly appeared on some vines close to his house. They were so numerous that the rattling as they struck the foliage attracted the notice of Mrs Schonfeldt, who called her husband's attention to the sound. The day was warm, and consequently the beetles flew rapidly. As a rule, we believe, dispersion occurs more by a wandering individual flight than by movements in swarms. There is a marked tendency among the beetles to desert unthrifty vines, probably because of the poor shelter they offer, and to attack the

more vigorous, thrifty vineyards. It may be that a slight overcrowding, as in the case of some other insects, impels the beetles to flight. This means that poor vines are relatively safe, while the better ones are liable to injury and are consequently the places where it is most important to control the insect. These inflying beetles will lay eggs if conditions are favorable, and the earlier they appear the more eggs will be deposited.

Eggs. The eggs of this insect are deposited almost entirely under the loose bark of last year's wood, many being found as high as the top wire. Professor Webster states that over 700 have been taken from a single vine, and from a section 16 inches in length and an inch in diameter he took 225 eggs. Once he found a few eggs pushed down between the earth and the base of the vine, but we have failed to find eggs in any such position. Beetles in confinement deposited eggs in crevices and cavities of the wood and even on leaves. Eggs were found in the field in 1902 as early as July 9, and oviposition was still in progress Aug. 15, and, though beetles were less abundant than three weeks before, it was still easy to find individuals which contained fully developed eggs. The first deposited in 1903 were found about July 3, and in our indoor breeding cages oviposition continued till into September. Experiments were planned, both this year and last, to determine the duration of the period of oviposition, the time when the eggs were laid and the total number deposited by females. A number of pairs of beetles were isolated and provided daily with fresh food. The work in 1902 demonstrated that a number of beetles might continue to deposit eggs for a period of over 40 days, and certain individuals from seven to 13 days. These records gave totals of 187, 141 and 106 eggs for individuals. This was interesting, but it was felt that the limit had not been reached, and consequently the studies were conducted on a more extended scale this year, and the results more than justified the labor, as will be seen by the appended table.

Oviposition experiments with Fidia 1903

Beetles taken at Westfield July 2

		Pair 1	Pair 5	Pair 19	Stock jar 1	Stock jar 3	Check plant
July	4	30	.....	.....	(40♂)	(17♀)	(4♀)
	5	20	.....	.....	77	.....	.....
	6	21	.....	.....	25	.....	.....
	7	26	.....	.....	225	.....	.....
	8	20	.....	.....	30	75	.....
	9	25	.....	35	450	150	145
	10	35	.....	.....	300	175	40
	11	25	.....	.....	400	150	.....
	12	30	.....	10	650	100	.....
	13	25	.....	10	200	250	50
	14	.....	.....	.....	150	40	25
	15	31	.....	.....	175	45	.....
	16	.....	140	.....	30	.....	150
	17	.....	.....	.....	100	.....	.....
	18	33	25	.....	175	125	25
	19	.....	.....	.....	120	.....	25
	20	.....	.....	.....	20	.....	50
	21	24	.....	.....	62	175	70
	22	.....	.....	75	25	10	40
	23	41	.....	.....	30	35	.....
	24	30	.....	26	200	50	75
	25	.....	.....	.....	264	50	85
	26	24	.....	.....	185	300	160
	27	30	.....	.....	70	25	25
	28	.....	.....	.....	62	.....	.....
	29	20	.....	.....	50	.....	50
	30	.....	.....	.....	130	50	50
	31	10	25	.....	185	115	128
August	1	42	60	.....	25	105	54
	2	.....	.....	.....	.....	50	70
	3	.....	20	.....	150	.....	75
	4	11	.....	All dead.	.....	76	.....
	5	.....	.....	.....	75	.....	130
	8	.....	.....	.....	75	.....	.....
	10	56	.....	.....	58	18	.....
	12	a16	72	.....	73	.....	95
	13	2	.....	.....	123	.....	83
	14	36	.....	.....	25	.....	.....
	15	.....	.....	.....	36	.....	.....
	17	42	.....	.....	90	23	36
	19	.....	.....	.....	60	.....	.....
	20	45	.....	.....	75	.....	.....
	21	.....	.....	.....	35	.....	35
	22	36	.....	.....	70	.....	166
	24	25	All dead.	.....	40	15	28
	26	.....	.....	.....	39	.....	.....
September	2	56	.....	.....	.....	.....	.....
	4	14	.....	.....	.....	.....	.....
	6	31	.....	.....	.....	.....	.....
	11	♀ dead...	.....	.....	.....	.....	.....
Totals.....		902	342	156	5 664	2 199	1 955
Average per female.....		.....	.....	.....	141	192	488

a 4.30 p. m.

An examination of the above record shows that one female taken July 2 began laying eggs July 4 and from then to the 13th deposited from 20 to 30 daily, and from the latter day onward the eggs were laid usually at intervals of one to several days, the periods of deposition being interspersed by intervals of feeding. There seems to be a very direct connection between the amount eaten and the number of eggs laid, which would be expected when it is remembered that a single female lived upward of two months and during that time deposited the enormous number of 902 eggs. This record is a striking testimony to the care bestowed on the insects by Mr Walker, who had charge of the breeding cage work. Analysis shows that 257, or over one fourth of the total number, were laid during the first 10 days, and 416, or nearly one half of the total number, in the first three weeks. This record is undoubtedly exceptional and probably approaches the maximum capacity of the insect, particularly in the field. It will be seen, however, that one other female deposited 342 and another 156 eggs, while averages of beetles kept in certain stock jars ranged from 141 to 192 and 488 to each female, and an average based on the entire record gives nearly 175 for each female. This indicates that our highest record, 902, may not be so very exceptional. A study of the entire number of eggs is not without interest, as it shows when the greatest number are deposited and consequently the time when the beetles should be destroyed in order to obtain the maximum benefit. A summarized table is given below.

Summary of oviposition record 1903

DATE	Pair 1	Pair 5	Pair 19	Stock jar 1	Stock jar 3	Check plant	Total	Per cent of total
July 4–18	321	165	55	2 987	1 110	435	5 073	45
July 19–31	179	25	.....	1 403	810	758	3 175	†28
July 4–31	500	190	55	4 390	1 920	1 193	8 248	†73
Totals, July–Sep.....	902	342	156	5 664	2 199	1 955	11 173	.....
Average per female.....	902	342	156	141	192	188	.....	.....

It will be seen from an examination of this that 5073 eggs were deposited by all of the different beetles in the various jars between July 4 and 18 (or the first two weeks) making a total of

45% of the entire number, and that only 3175 were deposited between July 19 and 31 (or the following 12 days). It will also be observed that 8248 eggs were deposited by all the beetles during the month of July, and this amounts to over 73% of the entire number produced by the beetles under observation. In other words, a very large per cent of the eggs are deposited under normal conditions during the first two weeks after the beetles begin to lay, or during the first three or three and one half weeks of their existence. There is then a decided drop during the next 10 or 12 days, and a much greater falling off in the following weeks. This record probably represents very closely indeed what actually occurs in the field and emphasizes the necessity of destroying the insects early in their career, though it will be observed that considerable protection results even if the pests are not killed till three or four weeks after they appear above ground.

The beetles which made the records both this year and last were confined in jelly tumblers or fruit jars and were daily supplied with small pieces of cane and fresh leaves. Careful records were kept of all insects taken from the individual tumblers as well as the large breeding jars, and, while the conditions were by no means normal, it is manifest that valuable results were obtained. In nature, it is probable that natural causes would result in the death of many individuals early in their career, and the same is true in the breeding jars, though deaths in the latter are usually the result of confinement and unnatural conditions. One to a certain extent offsets the other, and the above records may be considered as giving a fair idea of what actually occurs in the field.

Our observations on eggs laid in breeding jars showed that they are deposited in masses of from 1 to 125, the latter being the largest number observed in one cluster. A normal egg mass measures about $\frac{1}{8}$ inch in length and less than one half that in breadth. The somewhat concentric arrangement of the eggs is shown on plate 1, figure 3. The rows of eggs often overlap each other like shingles, and in the center of the mass there is frequently an appearance of two or three layers. The egg clusters are sometimes deposited so that two thirds of the branch is encircled, and in each case the whole mass is covered with a sticky substance, which glues each egg to the other in

such a manner that the whole may be easily detached from the vine, as is often the case when a strong wind is blowing.

The duration of the egg stage was determined by repeated observations both last year and this as from 9 to 12 days, about one day being required for an entire mass of eggs to develop after hatching commenced. We were also able to verify Professor Webster's observation on the appearance of a narrow semitransparent band or line near each end of the egg four days after oviposition. Small numbers of empty egg shells, indicating that hatching had begun, were found in Mr G. L. Hough's vineyard July 24, 1902; and it is very probable that in Mr Clyde Dean's vineyard at Portland, where conditions are about a week earlier, young grubs had appeared some time before.

Habits of the grubs or larvae. The young larvae, after they hatch from the eggs, drop to the ground, as observed by Professor Webster and corroborated in our own experience. There seems to be very little or no attempt on the part of these tiny creatures to crawl down the stalk. A recently hatched grub is such a small creature that it rapidly makes its way into any crevice or crack, and when it drops on loose earth soon disappears from sight. Earlier writers have recommended the covering of the roots of grapevines as deeply as practicable at the time the young hatch, so as to present more obstacles to the grubs when making their way to the roots. This suggested to the writer some experiments to determine the burrowing and traveling powers of these little creatures. One small grub was placed on a piece of paper at 9.27 in the morning and its wanderings carefully traced with a pencil till 4.43 in the afternoon. The little creature traveled almost continuously during that entire period and showed a decided tendency to turn to the left. It covered the relatively enormous distance of over 47 feet in seven hours, or an average of about 2 yards an hour. The grub was placed in a dry vial, and under such unfavorable conditions lived about three days. This would seem to indicate that the little creatures can make their way over many obstacles if not confronted by very unfavorable conditions.

Some tests were also planned to ascertain the burrowing powers of these little grubs. A glass tube 17 inches long and ½ inch in diameter was bent so that 4 inches were vertical. It was then *filled with* loosely packed earth, and on July 29, 40

recently hatched grubs were placed on the surface of the soil in the 4 inch vertical portion. One grub had made its way through the entire mass of soil by July 31, another by Aug. 1, and 11 others by the 3d, making a total of 13 which had traveled the whole length of this tube in a period of four days.

Another ½ inch tube, 10 inches long with 3½ inches vertical and 6½ inches of its length horizontal was similarly packed and 13 grubs placed on the surface of the soil July 29. Four of these had made their way throughout the entire length of the tube by Aug. 3. Another tube 12 inches long, ½ inch in diameter, with 2½ inches of its length vertical and the remainder horizontal was filled with tightly packed soil and a number of grubs placed in it Aug. 1. On the 7th one grub had made its way through 7½ inches of this tightly packed material. It would seem from the above experiments that, while a great many grubs undoubtedly perish in making their way from the vine to the succulent roots on which they feed, they are capable of overcoming great obstacles, and the facts ascertained above at least raise a question as to the advisability of attempting to interpose barriers between the grub and the roots on which it feeds.

The young larvae or grubs are undoubtedly able to exist for some time without food. They soon make their way when possible to the young feeding roots, where they may sometimes be found in considerable numbers. The writer, in the middle of August 1902, succeeded in finding eight of these little creatures under a small bunch of feeding roots. They were less than one quarter grown, and under larger roots near them several others were found which were about half grown. Aug. 18, 1903, quarter and nearly full grown grubs were found in some Westfield vineyards. The occurrence of few half grown larvae and of considerable numbers of nearly full grown individuals the middle of September 1902 indicates that these creatures develop very rapidly after they have found suitable roots on which to feed. The finding of a small grub scarcely $\frac{1}{16}$ inch long July 2 shows that some do not attain their full growth in the fall, since this individual could not have hatched from an egg laid in 1902, as the beetles had hardly begun to appear, and that such individuals must feed to some extent in the spring. It seems probable that these very small grubs produce the later emerging beetles and are

therefore responsible to a limited degree for the very extended period during which adults are found abroad. Most of the grubs complete or nearly complete their growth in the early fall, and on the approach of cold weather descend deeper in the earth. Professor Webster records finding the grubs a foot below the surface in the spring, and our own observations indicate that they descend nearly to that depth, where they pass the winter in small oval cells. Their ascent in the spring occurs after the appearance of warm weather and probably some time in early May. Experiments in 1903 with grubs collected the latter part of April demonstrated the ability of full grown and apparently half grown larvae to complete their transformations with no more nourishment than is found in ordinary garden soil in which there are no grape roots. Those about quarter grown were not able to survive the test. On the other hand, some nearly full grown individuals were observed last spring feeding on the roots to a slight extent in our breeding cage.

Pupa. Professor Webster records the finding of a very few pupae as early as the first week in June, and Mr Barden states that in 1902 he observed the first pupae at Ripley June 7, though Mr Hough is of the opinion that the larvae began to transform as early as June 4. The great majority of the insects had transformed to this stage by June 23. The present season was considerably more advanced than that of last year, and 90% of the insects were in the pupal stage May 29, 1903, on light sandy loam. The cells are almost entirely within 2 or 3 inches of the surface and usually within 2 or 3 feet of the base of the vine.

The duration of the pupa stage has been stated by earlier writers as about a fortnight and actual observations with breeding cage material have enabled us to determine this period as from 13 to 14 days. These observations were made in the office, where temperature conditions were uniform and rather high, and it would not be surprising if this period was materially extended out of doors in unusually cool weather.

The oval cells occupied by the larvae can be broken repeatedly, and the grubs will make others, but such is not true of the pupae. The insects are so delicate in the latter stage that the writer has experienced great difficulty in transmitting them through the mails, even with most careful packing. This is shown by the fact that out *of 58 mailed to* Albany only 15 arrived alive; a number

were carefully packed in their cells or laid on moist cotton, otherwise the fatalities would have been much higher. Cage experiments in the field show that from 50% to 75% or even a larger proportion may be destroyed by timely cultivation [*see* p. 27]. These facts have a very important bearing on remedial measures, as will be pointed out under that head.

EXPERIMENTAL WORK IN 1903

This is a very convenient heading under which to group a number of records of work carried on under similar conditions, yielding data which can be readily tabulated and which should be discussed under various headings. This work was conducted in the vineyard of Mr D. K. Falvay of Westfield, who contributed not a little to its success.

Eight large, thrifty Concord vines of as nearly uniform size and conditions as could be determined by examination were carefully covered by wire cages [pl. 7, 8] so arranged that no insects such as Fidia could escape, nor could any enter from outside. The cages were numbered respectively from one to five, running from east to west. Numbers 1, 2 and 5 contained two vines each and numbers 3 and 4 but a single vine. Number 1 was a check cage, which was watched carefully for the purpose of comparing with conditions obtaining in other cages. Number 2 included two Concord vines around which the soil had been carefully hoed at the time the majority of the insects were in the pupal stage. The work was not more thorough than could have been done by a horse and cultivator. The vine in number 3 was sprayed with arsenate of lead, 1 pound to 50 gallons of water. The first application was made June 19 and the second June 27. The work was done by Mr Barden, who used a small hand atomizer and took special pains in each instance to cover every portion of the foliage so far as was possible. The vine in number 4 was sprayed with a poisoned bordeaux mixture, 6 pounds of copper sulfate, 6 pounds of lime and ¼ pound of paris green being used to 40 gallons of water. The spraying was done by the same person and in the same manner as in the case of cage 3. The vines in number 5 were reserved for the purpose of determining exactly when the beetles appear above ground, and it was visited at intervals of a few days to a week or thereabout and the beetles removed till practically all had emerged. The tabulated record is as follows·

Record of cage experiments 1903

DATE		1 Check	2 Cultivation	3 Arsenate lead 4 lb to 50 gal.	4 Poisoned bordeaux mixture	5 Beetles collected
June	5	.....	Carefully hoed to depth of 3 in.....	.....	.....	.....
	19	.....	.....	Sprayed thoroughly....	Sprayed thoroughly....	.....
	22	8 beetles.....	2 beetles.....	24 beetles.....	18 beetles.....	22 beetles
	24	19 beetles.....	7 beetles, practically no feeding	36 beetles, some feeding	32 beetles, some feeding	75 beetles
	25	.....	.....	.....	.....	50 beetles, 6 p. m.
	26	41 beetles.....	10 beetles, much recent feeding	56 beetles, more feeding	56 beetles, more feeding	50 beetles, 11 a. m.
	27	.....	.....	Sprayed second time ...	Sprayed second time....	.....
	28	.....	.....	.....	.....	31 beetles
	30	.....	.....	.....	.....	123 beetles
July	1	141 beetles, considerable feeding	45 beetles.....	72 beetles, 1 recently dead, considerable feeding	90 beetles, 5 wing cases (representing 3 beetles), 1 hanging dead	41 beetles
	2	.....	.....	.....	.....	33 beetles
	6	.....	.....	None dead.....	None dead.....	57 beetles
	7	.....	.....	.....	.....	6 beetles
	14	.....	.....	None dead, few living, 3 egg clusters	None dead, few living, 5 egg clusters	8 beetles
	21	Fewer beetles than in 2, 3 or 4 and fewer eggs than in 3 or 4	Beetles more numerous than in 3 or 4, less feeding than in 1, 3 or 4	6 egg clusters and more beetles and more feeding than in 4	Very few beetles, 6 small and 5 fair sized egg clusters	13 beetles
Aug.	1	7 beetles.....	1 beetle.....	None.....	None.....	2 beetles
	18	None.....	None.....	None.....	None.....	No beetles. Total 511

It will be seen, on comparison between the cage in which cultivation occurred and the number of beetles observed in cages 1, 3, 4 and 5, that a large proportion of the insects must have been destroyed by this means. In all probability over 50% and possibly 75% or even more, were killed by cultivation, because we find that on July 1 there were 141 beetles in cage 1, and in cages 3 and 4, which should be added together as each contains but a vine, there were 162, while in cage 5 we had obtained at that time nearly 400 insects. In cages 3 and 4, it will be observed that there were 72 and 90 beetles respectively living July 1, 12 days after the first application of poison. One dead insect was found in cage 3 and five wing cases, representing three individuals, and another hanging in cage 4. The conditions, however, in these two cages, as compared with the others at the same time, were so similar that we could not be certain that the relatively few insects found dead had been killed by poison, and the same was true on July 6, 14 and subsequent dates. A study of the record of captures in cage 5 showed that a very large proportion, 92%, of the beetles appeared above ground within two weeks after the first insects were observed abroad. In other words, we bred from the soil about two vines 511 beetles, 477 appearing in the first two weeks.

The experimental vineyard,[1] which was selected only after extensive examinations in different vineyards in the Chautauqua grape belt, appeared to be a place where the insects were rather abundant and yet had not caused very serious injury unless it was in the immediate vicinity of the cages. The plot selected

[1] The cultivation of this vineyard is of interest, and data relating thereto, kindly placed at my disposal by Mr Falvay, is as follows: Ap. 28 the vineyard was gang-plowed, and was horse-hoed the 30th; May 4 it was hoed by hand; May 7 harrowed with a spring-tooth harrow; May 11. 350 pounds of kainit to an acre applied; May 14,* one furrow on each side of the row was turned toward the vines; May 22, the space between the furrows was cultivated; June 5,* horse-hoed for Fidia, following with the cultivator; June 16, cultivated for Fidia. Each process required about a day, and the cost for 5 acres was placed at $27. The additional cultivation (*) for Fidia amounted to $8.50. The vineyard since Aug. 1, in addition to that given above, has been gang-plowed, harrowed with a spring-tooth harrow and cultivated, each operation twice in a row and one after the other and followed by cultivation with an acme harrow. The vineyard is showing the effects of good treatment and has developed a very satisfactory amount of wood in spite of previous root worm injury.

was the portion just south of Mr Falvay's packing house, extending over a gravelly knoll into a loamy hollow. The region next to the packing house contained comparatively few insects, which was probably due in considerable measure to a neighbor's chickens working in that section. The first 24 rows south of the packing house were reserved largely for demonstrating the effectiveness of collecting, and no cultivation for the destruction of pupae was allowed on its six southern rows and also on the next six rows of the adjacent plot. The next plot of 13 rows was sprayed with arsenate of lead, 5 pounds to 50 gallons of water. The application was made July 26 and special pains were taken to cover the vines as thoroughly as possible. The 11 rows south of the arsenate of lead plot were sprayed the same day and in the same manner with poisoned bordeaux mixture, 6 pounds of copper sulfate, 6 pounds of lime and ¼ pound of paris green being used to 40 gallons of water. The next two rows were not sprayed, but were left as checks, and the following 11, namely those just north of the cage except one, were sprayed with an arsenate of lead mixture as described above. The spraying with poisoned bordeaux was thorough, though not quite so carefully done as in the case of the arsenate of lead. At the time the application was made there was a considerable evidence of feeding in the section next the cages and also in that sprayed with the poisoned bordeaux mixture. The row just north of the cage and that on which the cages stood received no poison.

Insects taken by the beetle catcher. The operation of the beetle catcher over 5 acres resulted not only in capturing a large number of Fidias but also in taking a number of other species. The list is of interest because it indicates in a measure the excellent cultivation and care which this vineyard has received. It will be observed that no species appeared in any numbers compared with those of Fidia, which fact alone is of considerable value in indicating the care and clean culture given the vineyard. A few caterpillars and other soft bodied larvae were taken but in relatively no larger numbers, and no attempt was made to count them. The list follows, and it will be seen that the number taken of any species is so small that practically all may be neglected, as regards either beneficial or injurious powers.

NUMBER OF VARIOUS INSECTS TAKEN IN BEETLE CATCHER

COLEOPTERA

1 Calathus gregarius *Say*, July 7, 14, 26
1 Bradycellus rupestris *Say*, June 26
2 Megilla maculata *DeG.*, spotted lady bug, July 7
1 Coccinella 9-notata *Hbst.*, nine spotted lady bug, June 26, July 7
1 Chilocorus bivulnerus *Muls.*, twice stabbed lady bug, June 26
10 Brachyacantha ursina *Fabr.*, June 26, July 7
2 Tenebrioides corticalis *Melsh.*, June 26
1 Melanotus communis *Gyll.*, June 26
2 Asa hes baridius *Say*, June 26
2 Pyropyga nigricans *Say*, June 26, July 7
1 Telephorus carolinus *Fab.*, June 26
1 Hydnocera *sp.*, June 26
1 Macrodactylus subspinosus *Fab.*, rose beetle, June 26
1 Pelidnota punctata *Linn.*, spotted grapevine beetle, July 1, 14
1 Xylotrechus colonus *Fab.*, July 1
1 Euderces picipes *Fab.*, July 14
1 Eupogonius tomentosus *Hald.*, June 26
1 Doryphora 10-lineata *Say*, July 14
1 Disonycha xanthomelaena *Dalm.*, June 26
6 Haltica chalybea *Ill.*, steely flea beetle, June 26, July 14
1 Crepidodera helxines *Linn.*, June 26
1 Doryphora clivicollis *Kirby*, June 26
4 Systena taeniata *Say*, pale striped flea beetle, June 26
1 Notoxus monodon *Fab.*, June 26
20 Otiorhynchus ovatus *Linn.*, ovate snout beetle, June 26
1 Phytonomus punctatus *Fab.*, punctured clover leaf weevil, July 1
1 Conotrachelus nenuphar *Hbst.*, plum curculio, June 26
1 Hylobius pales *Hbst.*, Pales weevil, July 7

HEMIPTERA

1 Canthophorus cinctus Beauv., July 14
1 Euschistus tristigmus *Say*, July 1
1 Nezara hilaris *Say*, July 1, 7
8 Lygus pratensis *Linn.*, tarnished plant bug, July 14
1 Thamnotettix clitellaria *Say*, June 26

Observations showed that the red-headed flea beetle, Systena frontalis Fab., was somewhat abundant in Sheridan vineyards July 21 and relatively much more so than in and about Westfield, where most of our experimental work was done.

Food plants. This beetle has a comparatively restricted food habit. It was early observed by Mr Walsh on grapevines, and the late Professor Riley recorded its feeding on the American redbud, Cercis canadensis. It is also known to feed on the native Virginia creeper, Ampelopsis quinquefolia.

Varieties affected. The Concord, as is well known, is almost universally grown in the Chautauqua region, and consequently is one that has suffered to the greatest extent from injuries by this pest, though our observations convince us that the Niagara is even more liable to injury, and in the cases we have seen the difference was quite marked. Referring to Ohio reports, it will be seen that Mr Maxwell states that Wordens and Brightons were killed first, while Concords and Catawbas were not so badly in-

jured, and in a later report he states that renewing a vineyard with Niagara vines seems to be quite a success. This latter point, we think, needs further demonstration. On the other hand it will be observed that Mr Slade considers that the Wordens and Catawbas suffer more than the Concords. The relative liability of different varieties to injury is probably influenced to a considerable extent by location and character of the soil, specially the latter, and it is therefore not surprising to meet with some discrepancies as to the relative amount of injury they suffer. Extended observations and probably careful experiments are necessary before authoritative conclusions can be reached.

GRAPEBERRY MOTH

(Polychrosis botrana Schiff.)

This species is present in more or less numbers in most vineyards, and as it was met with in the course of our experimental work on Fidia, and since this latter gave some valuable results on methods of controlling this fruit pest, a brief notice of it is included. This species is specially destructive in the vicinity of forests or in vineyards near which bushes of various kinds, particularly sumac, are allowed to grow. It is believed to have two generations in this country, the larvae of the first feeding on the blossoms and those of the second in the fruit. There is possibly a third brood. It is gratifying to state that we have obtained excellent results in controlling this pest with arsenate of lead and also the poisoned Bordeaux mixture. The spraying, done shortly after blossoming and while the fruit was not larger than a small pea, was primarily for the purpose of killing Fidias; but investigation this fall shows that it was much more effective in destroying young of the grapeberry moth, since there is certainly 50% less damage to fruit on sprayed than on unsprayed rows, even when the two are side by side. The difference was so marked that it was easily observed, and in walking between the treated and untreated areas, it was not hard to find infested clusters on the one side while on the other they were much less abundant. It was also observed that not only was this insect checked by spraying but the foliage was benefited by the treatment, having a better color and remaining on the vines a longer time.

Our experiments were in Mr D. K. Falvay's vineyard, and he informs us that last year a section of six or seven rows in his

vineyard next to a lot of sumac and other bushes, was so badly infested by this worm, that no attempt was made to pick it. The wild growth was cut away last winter and burned, and the fruit on these rows was no more infested this year than that of any other section of the vineyard.

We therefore advise clean culture, specially the destruction of bordering hedges and adjacent miscellaneous forest growths and the burning of debris in a vineyard, in order to lessen shelters where the insect may pass the winter. It is advisable to locate vineyards when possible at some distance from woods, and wherever they are infested to any extent by this pest, spray with an arsenical at least once after blossoming.

NATURAL ENEMIES

This serious grapevine pest is subject to attack by several natural enemies. Two interesting species of egg parasites, bearing the scientific names Fidiobia flavipes Ashm. and Brachysticha fidiae Ashm., were bred from eggs of this insect by Professor Webster in 1894, and in 1896 he expressed the belief that a marked decrease in numbers of the Fidia was possibly due to the work of these parasites. Professor Webster also observed a small brown ant, Lasius brunneus var. alienus, feeding on the eggs, and a small mite, provisionally identified for Professor Webster by Dr George Marx, as Tyroglyphus phylloxerae P. & R., extracting the contents of several eggs in succession, and also a smaller mite resembling Hoplophora arctata Riley. Another mite, Heteropus ventricosus Newport, was met with by Professor Webster in 1896 who credits it with being quite destructive to the eggs of this pest. One of these small mites, probably a species of Tyroglyphus, was observed in our breeding cages feeding on the pupae, one being almost entirely destroyed.

Several predaceous insects were found by us during field work, specially when digging for larvae in the early spring. The grubs of some carabid beetle were observed to be about two thirds as numerous as those of Fidia during the last of April, and it is very probable that they prey on this species. We were unable to bring any of the carabids to maturity. A small beetle, Staphylinus vulpinus Nordm., was associated

with Fidia grubs and possibly preys on them. The larva of an aphis lion, Chrysopa species, was observed by the writer investigating under loose bark where eggs were present, and it is not at all improbable that these insects destroy many.

REMEDIAL MEASURES

It was felt when this study was undertaken that there was a lack of definite knowledge regarding methods of controlling this insect and it was accordingly planned to make a thorough test of those advised as well as to experiment in other directions. Some of these investigations gave results which appear to have a positive value, while others only proved certain measures comparatively useless.

Destroying the pupae. There is no doubt as to the benefits of cultivating vineyards for the purpose of destroying the pupae, if the operations are properly carried out. In the first place, plan to have a moderately high ridge of firm earth about the base of the vines the latter part of May, so that the grubs will come well above the roots before transforming to the pupal or "turtle" stage. Then adjust operations so that horse-hoeing away from the vines will come early in June, thus avoiding special cultivation for the purpose of destroying the insects. It may be found, however, that some adjustment of the cultivator, so that it will work a little deeper, or a little extra care in keeping the implement close to the vine, will materially increase the efficiency of this operation. In 1902 our attention was called in the early part of June to a vineyard where there were from 50 to 60 grubs about many of the vines, while repeated search the latter part of the same month failed to discover more than three or four pupae under a vine and in many cases not a specimen. In the interval this vineyard had been carefully cultivated for the purpose of destroying the pupae, and we are of the opinion that this practice was largely responsible for the scarcity of the insects. This is further substantiated by our cage experiments in 1903 [*see* p. 27] which show that from 50% to 75% or more of the pupae can be killed by cultivation no more thorough than that given by horse implements. These data lead us to believe that much can be accomplished by planning cultural operations so that the vineyard will be horse-hoed at the time when the majority of the insects

are in the pupal or "turtle" stage. This operation may well b deferred till some of the more advanced insects begin to brown little or even till a very few have changed to beetles, and it efficiency can be further enhanced by repeating the cultivatio with a spring-toothed harrow, about a week or 10 days after i order to catch some of the later transforming individuals. The may be a difference of a week or more in the development of th insects in a vineyard, and this means that each grower shoul know the pupa and watch for its appearance. This variation due largely to the character of the soils, as some warm up muc more rapidly than others, and the final changes to beetles occu correspondingly quick.

Collecting beetles. This method of controlling the grapevin root worm did not promise much when it was first attempte Professor Webster had either not considered it worth tryin or had found it of comparatively little value, and Dr Marlatt di not even mention it in his recommendations. Professor Slinge land made the guarded statement in 1902 that it may be pra ticable in some cases to jar the beetles into a collecting apparatu but he apparently had little faith in the plan, except when th insects could be jarred to the ground where they would be eate by chickens.

Mr J. J. Barden, working under the writer's directions in 190 found that, even with a plain cloth-covered frame several fe square and with a small slit in one side, so that it could be slippe under a vine, large numbers of the insects could be collecte With this crude apparatus he was able to capture a quart beetles in about two hours. This indicated that much bette results could be secured with a more elaborate apparatus; an with the aid of Mr G. L. Hough he constructed a modified for of the Curculio catcher, which is represented on plate 9. Th machine is 6 feet long and 3 feet wide at the top, with vertica ends and the sides sloping to a trough about 3x3x72 inche A central slit about 3 inches wide was cut in the side opposit the handles and the whole mounted on a two wheeled fram The long trough is subdivided by a few transverse partition and these spaces are partly filled with kerosene and wate The sides, ends and trough are constructed of galvanized iro and strengthened with iron straps as shown in the figure. Th

wheels are from a toy cart and the handles and frame are home-made. The method of operation is simply to wheel the machine between the rows, and then, elevating the handles, to slip the farther side under the wire, and the trunk of the vine entering the slit permits the placing of the machine directly under the vine. It then remains for the operator to jar the insects off. Mr Barden found that it required several shakings to dislodge all the beetles. In one case he succeeded in catching 64 by jarring a vine once. It was found advantageous to have three machines operating together and placed simultaneously under adjacent vines. This arrangement facilitated the work very greatly and reduced to a minimum the beetles jarred from vines before a machine could be placed under them.

This method appealed so strongly to Mr Hough, who by the way is a very practical business man, that he used it daily for a time on certain badly infested vines, and found that, in the case of the third jarring, he did not get over three or four beetles to a vine, whereas at the first operation 40 to 50 were secured and 15 or 20 at the second jarring. An examination in this vineyard July 24 showed that the beetles were not nearly so abundant as two weeks before, largely due to four collectings in two weeks. The Hough beetle catcher was further tested in 1903, with the result that 1343 beetles were taken June 26 from approximately 110 vines, or an average of over 12 to a vine. The principal difficulty with this device is the relatively large amount of time consumed in placing it under a vine and making the necessary jarrings.

Collecting beetles, if rapidly done, appeared to be a feasible method of checking this pest and our plans contemplated a rigid test of its possibilities in 1903. Mr F. A. Morehouse of Ripley designed an improved form of catcher, the essential idea of which is continual motion and jarring. We arranged to have one built and thoroughly tested, believing the situation justified the experiment, and the results have been most gratifying. This machine, illustrated on plates 10, 11, 12, is essentially a pair of troughs on wheels and is drawn through the vineyard astride the row. The troughs are connected over the vine by bracing arms and wires (placed high enough to clear all posts) and are hung by ½ inch iron rods, which permit the side

springs to push the troughs under the vines so that their inner edges are close to the stems or posts as the case may be. The outer slope of each trough is a 3 foot strip of oilcloth stretched over a frame, while the inner is a 10 inch rubber belt 11 feet long. These sloping sides guide the insects so that they fall into the eaves trough, which is divided into small sections by a number of water-tight compartments each of which contains a quantity of water with a small amount of kerosene floating on its surface. The whole machine, as will be seen by the illustrations, is a home-made affair, and was built simply to test the practicability of the idea. The dimensions are as follows: length 12 feet, width 5 feet, hight 7½ feet, length of trough 11 feet, of runners for same 12 feet, diameter of wheels 2½ feet. It can undoubtedly be made considerably more efficient; the troughs, for example, should be broader in order to accommodate more insects and debris. The common wooden springs could be replaced by steel ones and the rough wooden wheels by well made wooden or iron ones, and, instead of being on a fixed axle, it would be a decided advantage if they were on a swivel axle. All these improvements can be easily made later in case the machine commends itself to growers. This device was drawn over two rows of approximately 120 vines and took therefrom 1583 beetles, or an average of about 13 to a vine. This was at a time when not over 17 could be counted on a vine, though there were probably more. The entire operation consumed less than 20 minutes, and, somewhat to our surprise, the efficiency of the machine appears to be a little higher than that of the Hough beetle catcher. It was also operated over nine other rows and 3300 beetles secured, an average of about six to a vine. These rows were not quite so badly infested as the two mentioned above. The record of collecting with this machine, in addition to that above, is of interest and is given herewith.

July 2, 2650 beetles were taken from two check rows, which were in reality but one and one half rows, owing to many of the vines being very small and some missing. June 30 and July 1, 72,000 beetles were captured with this machine from all the experimental plots. July 7, 34,550 and July 14, 8380. Comparing the last three catchings, which were all from the entire area, it will be seen that there is a decrease of over 50% between the catch of July 1 and 7 and that the catch of the 14th was less

than 25% of the catch on the 7th. About 154,900 beetles were taken from this area of approximately 5 acres, 3 of which were much less infested than the 2 next the experimental cages. This means that an average of 59 beetles was secured from each vine in spite of the fact that a considerable proportion of the area had been previously cultivated for the special purpose of destroying the pupae. These figures give some idea of the immense number of insects which must have been in the vineyard when work was begun last spring.

As further evidence of the value of collecting for this insect, it may be interesting to state that last spring, sample diggings under different vines in the experimental area, gave from 8 to 50 or more grubs or as calculated from 60 to 400 or more to a vine, in one case it was estimated that there were fully 1000 under a single vine. Sample diggings in October resulted in obtaining no grubs from three vines, one only from each of three, and two only from two others, indicating that there were very few which had more than 12 or 15 grubs, and that, in all probability, the number to each vine would hardly exceed eight or nine. In other words, cultivating and collecting in one season reduced the number of grubs about 98%. These figures are sufficiently striking, so that no further comment is necessary on the efficiency of collecting and destroying the beetles; in fact, this vineyard after one season's work may be considered more free from the pest than almost any other in that section, and it will compare very favorably with those in places where Fidia has caused practically no injury.

Our experience with collectors has demonstrated the practicability of catching the beetles, and we recommend this operation for all badly infested sections, and that the collecting be begun as soon as the beetles appear on the vines in any number, say, when there are 12 or 15 on one. The operation should then be repeated at intervals of five to seven days till the vines have been gone over two, three and possibly four times, dependent somewhat on the number of insects which are captured. It will be found that it is much easier to catch the beetles on warm days, when it should be done, than in cool weather.

It may be added that the efficacy of a machine of this character could be materially increased by the adoption of various devices which would tend to lessen the open spaces under the vines and to increase the length of the catching surface. It is interesting in this connection to note that vineyardists in Missouri have been resorting to various catching devices for the protection of their vines from this pest. Many of them employ simple sheets and jar the beetles on them, while others are using a wheelbarrow arrangement on the suggestion of Professor Stedman.

Mr R. S. Blowers, of Portland, after examining the work of our beetle catcher at Westfield, constructed a very effective and cheap device [pl. 13], which is at least worthy of illustration and comment in this connection.

Its essential features are two long frame troughs covered with oilcloth, which hangs over an eaves trough divided into watertight compartments, as in the ordinary catcher. These two sections are each 24 feet long, the outer edge about 3 feet high, while the inner edge is approximately 18 inches high, and each is braced so that a man can pick it up at the center and move it toward or away from the vines. The original plan was to carry it through the vineyard and place it between the posts, jarring the vines and continuing in this manner. This was found rather laborious, and the work was made lighter by the construction of a pair of low bobsleds, fastened together by wires so that each was about 6 feet from the end of the trough, which at this point was provided with a transverse broad base so that it would rest on the bob without tipping. The inner edge of each bob was also provided with a small roll, so that the operator, by tipping the trough slightly toward the row, could roll the entire structure under the vines and, after jarring was completed, could roll it back. A horse was used to draw each half of the collector, and in this way about 3 acres a day could be gone over. This collector has the advantage of being comparatively cheap, since the outside expense for it would not exceed $9 for each half, or a total of $18. Most of the material, except the oilcloth, can usually be found around a farm, and the actual outlay, if the vineyardist made it himself, would be very little.

The late Prof. C. V. Riley, in his report for 1868, calls attention to the fact that one man whose vineyards were very badly infested by this insect had trained his chickens to go between the vines and pick up the beetles as they were dislodged by jarring. Mr F. A. Morehouse of Ripley, who has many chickens in the near vicinity of his vineyard, has practised the same thing with excellent results. The only trouble is that this method has a comparatively limited application, since it is not always practical to have chickens in large vineyards.

Arsenical poisons. A number of experiments were tried with arsenical poisons in 1902 for the purpose of ascertaining their efficiency in controlling this species. Two brands of arsenate of lead and paris green were used. Breeding cage experiments with arsenate of lead, using 2 pounds to 50 gallons of water, showed that seven days were required to kill 9 out of 10 beetles, and that, when 4 pounds of the poison were used to the same amount of water, all of the insects were killed within eight days. The spraying in both instances occurred July 5, and the record is as follows:

2 POUNDS OF ARSENATE OF LEAD TO 50 GALLONS OF WATER

July	7, 6 beetles dead	July 10,	another beetle dead
	3 alive	July 11	"
	1 missing	July 12	"

4 POUNDS ARSENATE OF LEAD TO 50 GALLONS OF WATER

July	7, 4 beetles dead	July 10,	another dead
July	9, 4 more dead	July 13	"

It will be seen by examining the above records that in the case of the first over half were killed within 48 hours after the spraying, and in the second less than half within 48 hours and four fifths within four days. It should be added that in the above experiments the leaves were sprayed very thoroughly and the poison allowed to dry before the treated foliage was placed in the cage.

The breeding cage experiments with paris green were less successful than those with arsenate of lead, and, though in one experiment 20% of the beetles were killed within 48 hours after

spraying the leaves with 1 pound of the poison and 1 pound of lime to 100 gallons of water, and 40% more died within four days after the spraying, the general results were not at all satisfactory, and the reason therefor can not be given.

The breeding cage experiments with arsenate of lead would lead one to expect most excellent results in the field, but such was not the case last year, though this may have been due to the fact that the spraying was done shortly before considerable rain fell, and was followed by nearly daily precipitations. The initial application was made July 8, 1902, and repeated the 9th, the rain of the preceding day making it advisable to go over the entire field a second time. The ground at the time the spraying was done was so wet that it was almost impossible to drive a team slowly enough to do good work. Careful search in the vineyard eight days after failed to reveal a single dead beetle. July 31 there were plenty of beetles and many eggs in Mr Northrop's vineyard, where the vines had been sprayed. The necessity of two sprayings resulted in the application of considerable poison, and about five weeks after the treatment it was seen that the sprayed vines had developed very little new growth as compared with untreated ones. There was no perceptible burning, yet the edges of the leaves were somewhat crumpled, and it is very probable that the poison checked the development of the more tender shoots.

The breeding cage experiments in 1902 led us to expect excellent results in the field, and our not obtaining the same after making two applications was attributed largely to the excessively wet weather, which not only washed off the poison but interfered with work in the vineyard. Similar experiments in 1903 gave even less satisfactory results than the year before. It required nine days to kill three out of five beetles. Arsenate of lead and poisoned bordeaux mixture were severely tested in caged outdoor vines, as detailed on page 26, 27. It will be seen by consulting the record that, though the vines were sprayed thoroughly on both June 19 and 27, there were fully as many living beetles on both July 1, 13 days after the first application, as on the two vines in the check cage, and the same was true July 21. Careful observation, during the remainder of the

period when beetles were to be found in cages, failed to disclose any substantial difference between the insects on the poisoned vines and those on the untreated ones. These cage experiments were further supplemented, as detailed on page 29, by extensive spraying. This was done June 25, and July 1 no difference could be detected between the sprayed and the unsprayed vines. This, in connection with our cage experiments, led us to abandon reluctantly further outdoor tests, and the poisoned areas were collected over in order to prevent what we deemed would be an extensive deposition of eggs. In other words, no experiments, other than those confined to small tumblers where the beetles could obtain absolutely nothing except poisoned foliage, gave results which are at all decisive. The reasons for this are several: the beetles do not succumb readily to poison, and being more or less secretive by nature, feed to a considerable extent on under leaves and in concealed situations where it is difficult to throw the spray. In addition they have a marked tendency to feed on the more tender leaves, which at the time spraying should be done appear almost daily on vigorous vines. These factors make it very difficult to control the insect.

The most decisive results obtained with an arsenical spray are those published by Mr John W. Spencer of Westfield, in the issue of the *Grape Belt* for July 24, 1903, in which he gives some definite figures in favor of spraying. Our only regret in this connection is that his experiments were not conducted on rapidly growing vines, because in our judgment these need protection much more than those in poor condition and on which the insects, as previously pointed out, can not be controlled nearly so readily.

Several vineyardists sprayed their vines in 1903 for the purpose of controlling this insect, and as it was stated by various growers that the poison applications had been successful, at their request these vineyards were inspected by us the first week in October, and much to our regret, we found that the reported good results were more apparent than real.

An examination in the vineyard of Mr Frank Monfort, of Brocton, resulted in finding 5, 45, 10 and 9 grubs respectively under as many Concord vines. The first record relates to a

vine which had very poorly developed roots, and consequently was not a fair sample of conditions in the vineyard. Mr Monfort not only sprayed his vineyard twice with a power sprayer, making the first application at the time the beetles appeared and the second a week later, but went to the additional trouble of going over the entire area carefully with a hand pump for the purpose of spraying any which the machine might have missed. He certainly tried to do a thorough job, and yet sample diggings in an adjacent vineyard belonging to Mr Morse gave respectively 3, 6, 3, 6, 16 and 9 grubs under different vines. The two latter records could hardly be compared with those in Mr Monfort's vineyard because they were fully ¼ mile distant and relate to vines which were much more healthy and vigorous. It may be claimed that this is not a fair test of the poison and to a certain extent this is true, yet these are results obtained by a practical man in an earnest effort to reduce the pest, and as they agree with our own experience are not without value. The difference between 75 and 150 grubs under a vine, and 5 to 12 or thereabouts, represents in our mind the relative efficiency of collecting and poison sprays, and our judgment is that these figures mark the difference between protection and serious injury.

The evidence concerning the efficacy of poisons in Ohio, as pointed out on a preceding page, is somewhat contradictory. Reporting on work done in 1899 Professor Webster states that an examination of sprayed fields showed nothing to indicate that arsenate of lead would not prove entirely effective. This differs from some later experiments performed under his direction by Messrs Newell and Burgess, the unpublished records of which through the kindness of Prof. P. J. Parrott have been placed at my disposal. The summary of this later work is as follows:

"Where beetles were abundant last year and vines seemingly badly injured and the arsenate of lead or disparene used this year (1900) few vines have died and all appear in a more healthy condition, but this is true also where none of these insecticides were used, beetles appearing later and in less numbers than for several years." Professor Webster, at the writer's request, has commented on the above experiments as follows. He states that

early results, though satisfactory, were not thought by him to be conclusive, and that a marked decrease in the number of the beetles vitiated later experiments to some extent, so that he did not consider them as either conclusive in themselves or as disproving the earlier work of Mr Mally. He states that arsenate of lead must be tried thoroughly several times where conditions are such as to enable one to obtain decisive results either one way or the other before it will be safe to make definite statements. Professor Stinson reports only fair success in destroying the beetles with poisons in Arkansas.

It seems very probable, therefore, that some of the Ohio growers have been led to attribute the relative scarcity of these beetles to the use of poison whereas it may have been due almost entirely to natural conditions.

Mr T. S. Clymonts states that in his experience spraying with bordeaux mixture has proved of some benefit, since the beetles prefer untreated vines and will migrate to them if near by.

Mr J. W. Maxwell, Euclid O., writing under date of Aug. 29, 1903, states that he called Prof. F. M. Webster's attention to the insect in 1893 and adds that in all his experience, now extending over a decade, he has not found a poison that will "exterminate" the insects, or, in other words, that has given satisfactory results.

Prof. F. M. Webster has recently called our attention to a case in Bloomington Ill., where the owner of a badly infested vineyard, began spraying thoroughly with arsenate of lead. He says that the vineyard at the outset was in very poor shape, that now it is returning to somewhere near its normal condition, and that he fails to find the slightest indication of beetles except on one or two vines. This has been accomplished within two or three years; and the owner, Mr J. L. Lampe, attributes it to the use of the insecticide, with which Professor Webster is inclined to coincide. Our experience with the pest suggests that possibly many of the insects may have forsaken this vineyard because of its poor foliage and gone to others where there was better shelter, and that therefore the protection afforded by the arsenate of lead may have been overestimated. In a later communication, Professor Webster states that he has found great numbers of dead beetles under sprayed vines and none under those

free from poison, a fact that shows that some protection is afforded. This, however, was in a vineyard which had been seriously injured and was therefore not making much growth.

We have been to considerable pains in looking up evidence both for and against arsenical poisons and the above summary of results obtained in Ohio, in connection with the work done in New York and elsewhere, leads us to the conclusion that, while the arsenical spray may, under certain conditions, give some protection from this insect, either by driving away the beetles or possibly killing them, we are by no means certain that this will result, specially in the case of more thrifty vineyards, and we are inclined to believe that in some instances the benefits resulting from poison applications have been greatly overestimated. We do know, on the other hand, that collecting and killing the insects, if it be done early enough, means protection, and for the present we prefer to recommend the latter method of fighting the pest rather than to indorse the use of a poison, the general utility of which has not been proved for Fidia. Enough has been done to warrant more extended work with poisons and it may be that another year or two will enable us to determine their true value.

Destruction of the eggs. This seemingly difficult operation was accomplished by Mr William Barden of Ripley by rubbing the canes with a gloved hand. He found that most of the eggs were deposited on the middle shoots, and that the great majority of them were crushed by rubbing. The operation, though slow, is not necessarily very expensive, as a man could go over approximately an acre a day without difficulty.

We have also conducted some experiments to test the resistance of the eggs to insecticides and have learned that a whale oil soap solution, 1 pound to 4 gallons of water, has no effect on them. It is doubtful if they can be destroyed with a spray. The extended period during which eggs are deposited, however, renders Mr Barden's method of controlling the insect of somewhat questionable value, and its employment can be advised only when a vineyard is found to be badly infested with eggs, and there is, therefore, no other method of getting at the insects before the grubs commence their operations.

Pulverizing the soil and mounding. Prof. F. M. Webster, as a result of his studies, advised thorough cultivation of the soil during the hatching period, taking special pains to keep it banked up over the roots. Professor Webster's idea was that the young insects dropping in the dry sand would be quickly destroyed wherever exposed to the sun, that the looseness of the surface layers would prove a serious hindrance to their burrowing, and that the increased depth over the roots would also provide an additional barrier to the grubs. Thorough cultivation is undoubtedly a most excellent thing, and the additional vigor arising therefrom is a valuable asset in enabling the vine to withstand very serious injury. Our experiments on the traveling and burrowing powers of these little grubs, however, lead us to believe that this measure, so far as preventing access to the roots is concerned, is not of much value. This is confirmed somewhat by the experience of Mr T. S. Clymonts, who states that a seriously injured vineyard can be renewed by thorough cultivation, and that he has experienced no difficulty in doing this with flat cultivation. In fact, Mr Clymonts is of the opinion that mounding the earth about the vines is injurious in other ways and therefore does not advise it. He recommends cutting back the vines to the living wood, enriching the land liberally with stable manure and applying about a barrel of salt to the acre. Then he cultivates with a disk harrow or other tool which will not stir the earth to a great depth, since he believes that deep plowing cuts off a large number of roots and is very injurious to the vines. He states that in several cases known to him where this has been done and flat culture adhered to, badly damaged vineyards have been restored to a very satisfactory condition.

Carbon bisulfid. Prof. F. M. Webster instituted some rather extensive experiments with carbon bisulfid against this insect, and the summary of his results is as follows. He found that the substance could not be used to advantage in soil that was very dry or saturated with water, and that it must be used in that which is damp. He states that the most satisfactory results will probably follow its use in the spring, in a damp soil, when it is applied in such a manner as to fumigate the

roots without the fluid coming in contact with them. He recommends from 4 to 6 ounces for each vine and states that it is not possible to kill every worm about a vine, and that it is doubtful if the low price then current for fruit would justify its use. Growers in the vicinity of Cleveland have not used this insecticide to any extent since the time Professor Webster made his experiments, and they give the high cost as the reason for its not being adopted. It should also be added that considerable care is necessary or the vines will be severely injured.

Kerosene emulsion. Several writers have advised killing the grubs at the base of the vines by the use of a kerosene emulsion, which is to be washed to a greater depth by copious watering or subsequent rain. We have seen very few cases where the grubs were congregated sufficiently to warrant any attempt at killing them in this manner, and it hardly appears practical in a large vineyard.

Crude petroleum. It was hoped that it would be possible to destroy the grubs of this pest by the application of this substance to the soil, and there seemed a chance of using it to prevent the young larvae from making their way to the roots. Some experiments in the office, however, demonstrated that the grubs easily penetrated soil which had the surface layers moistened by a fine spray of the oil, specially if placed on the soil 30 minutes to half a day or more after treatment. This substance appears to have very little value in controlling this insect.

Effect of calcium carbid refuse on grubs. Our attention was called to this substance by the statement that it had proved very valuable against the Phylloxera in France. Some of the material was kindly sent us from the Union Carbide Co.'s plant at Niagara Falls, and various experiments with the grubs were tried. One part of this substance mixed with 10 pounds of soil was placed in a box and some grubs added. One was dead the next day after having burrowed about ¼ inch and two others went to the depth respectively of 1¼ and 2 inches. No additional fatalities occurred even after 10 days. Several other experiments gave the same general results, and apparently we can have no hopes of this substance being of value in this particular case.

Recommendations. Apparently no one method can be relied on to control this insect, and our recommendations may be summarized as follows. Plan cultural operations so that a firm ridge of earth may be horse-hoed from the vines or otherwise cultivated or disturbed when the great majority of the insects are in the pupal stage and take special pains to stir the soil thoroughly in the near vicinity of the stem. Thorough cultivation and well enriched soil will do much in aiding the vines to withstand attack. This, supplemented by collecting beetles, particularly with a device which will catch them without the delay incident to stopping at each vine, is advisable on badly infested areas during the first two weeks after the adult insects appear in any numbers. The latter may possibly be supplemented or replaced by thorough spraying with an arsenical poison, preferably arsenate of lead, when the beetles begin to appear. Evidence at hand regarding spraying for this insect is not satisfactory, and for the present we prefer to limit our indorsement to above named methods of known value. We believe that these two courses, intelligently applied, afford a most feasible and thoroughly practical solution of the difficulty.

BIBLIOGRAPHY

1886 **Walsh, B. D.** Pract. Ent. 1:99. (Injurious in Kentucky)

1867 —— Pract. Ent. 2:87–88, fig. (Original description and observations on habits and allied species)

1867 —— Pract. Ent. 2:118. (Injurious in St Louis and Bluffton Mo.)

1868 **Riley, C. V.** Noxious, Beneficial and other Insects of Missouri. 1st Rep't, p.132–33. (Brief general notice); same in Mo. State Board Agric. 4th Rep't 1868, 1869.

1870 —— Amer. Ent. and Botanist, 2:307, fig. 188. (Received from Bunker Hill Mo.)

1872 **Kridelbaugh, S. H.** Ia. State Hort. Soc. Rep't 1871, p.159. (Injurious to leaves, remedies)

1873 **Crotch, G. R.** Acad. Nat. Sci. Phila. Proc. 24:33-34. (Described as F. murina)

1879 **Stout, O. E.** Kan. State Hort. Rep't 9:89. (Brief notice)

1885 **Lefevre, Ed.** "Catalogus Eumolpidarum" Soc. Roy. Sci. Liege Mem. Ser. 2, v.11, separate, p.76. (Described as F. lurida)

1892 **Horn, G. H.** Amer. Ent. Soc. Trans. 9:198. (Synonymy and distribution)

1894 **Howard, L. O.** Insect Life, 7:48. (Injurious in Ohio)

1894 **Webster, F. M.** Ohio Agric. Exp. Sta. Newspaper bul. 140; Ohio Farmer, Sep. 27, p.257. (Injurious at Lawrence, Kan.); —— Oct. 4, p.277. (Injuries in Kansas); —— Oct 25, p.337. (Life history and results of experiments); —— Nov. 1, p.357. (Carbon bisulfid and enemies); —— Dec. 6, 27, p. 453, 505. (Remedial measures, distribution)

1895 **Dille, W. W.** Ohio Farmer, June 20, p.497. (Review Walsh & Riley life history, completes life history); —— July 11, p.37. (Results of experiments)

1895 **Webster, F. M.** Ohio Agric. Exp. Sta. Bul. 62, p.77–95. (Detailed account of investigations); Ohio State Hort. Soc. An. Rep't 1894–95, p.16–19. 1pl. (Summary account); Ohio Farmer, Aug. 22, p.147. (Identified from Kansas)

1896 **Marlatt, C. L.** U. S. Dep't Agric. Yearbook 1895. p.391–93. (Brief general account)

1896 **Murtfeldt, M. E.** Colemans Rural World, March, p.97.

1896 **Smith, J. B.** Ent. News, 7:82–83. (Comments on value of arsenical poisons)

1896 **Stinson, J. T.** Ark. Agric. Exp.. Sta. Bul. 43, p.114–16. (Injurious in Arkansas. Brief notice)

1896 **Webster, F. M.** U. S. Dep't Agric. Div. Ent. Bul. 6 n. s. p.69. (Decrease in numbers possibly due to egg parasites and a mite)

1897 —— & **Mally, C. W.** U. S. Dep't Agric. Div. Ent. Bul. 9 n. s. p.44–45. (Tobacco dust and kainit ineffective)

1898 **Marlatt, C. L.** U. S. Dep't Agric. Farmers bul. 70, p.9–11. (Reprint from yearbook for 1895)

1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.223–24. (Brief notice); same in Ent. State Exp. Sta. 5th Rep't, p.139–41.

1899 **Webster, F. M. & Mally, C. W.** U. S. Dep't Agric. Div. Ent. Bul. 20 n. s. p. 70. (Insect unusually abundant, serious injuries at Bloomington Ill.)

1900 **Slingerland, M. V.** Cornell Univ. Agric. Exp. Sta. Bul. 184, p.18–32. (Record of injuries in New York and general compiled account, after Webster)

1900 **Smith, J. B.** Insects of New Jersey, p.303. (Occurs throughout New Jersey and on Staten Island on grape and Ampelopsis)

1900 **Webster, F. M.** Ohio State Hort. Soc. Rep't 1899, p.771. (Arsenate of lead apparently very effective)

1901 **Howard, L. O.** U. S. Dep't Agric. Div. Ent. Bul 30 n. s. p.97. (Serious injuries at Bloomington Ill., continued)

1902 **Felt, E. P.** Country Gentleman, May 15, 67:413. (Brief general account with outlines of proposed experiments); —— July 10, p.574–75. (Pupae readily destroyed by cultivation); State Entomologist. 17th Rep't 1901, 1902, p.733–34, fig. 8 (established about Ripley, collected about Albany in 1880), p.837 (partial bibliography); same in East. N. Y. Hort. Rep't. 6th An. Meeting 1902, p.215–16; U. S. Dep't Agric. Div. Ent. Bul. 37 n. s. p.102–3. (Injuries in Chautauqua grape belt)

1902 **Slingerland, M. V.** Cornell Univ. Agric. Exp. Sta. Bul. 208. (Investigations and remedies)

1903 **Felt, E. P.** N. Y. State Mus. Bul. 59, p.49–84. (Detailed account, specially of recent work); same in Grape Belt, issues for Jan. 9, 13, 20, 27 and Feb. 3 and 10; Country Gentleman, Mar. 19, 68:255. (Corrects reported error); N. Y. State Fruit Growers Ass'n. Rep't. 1903, p. 94. (Brief account); Grape Belt, June 16, p. 2. (Remedial measures); American Agriculturist, June 20, 71: 648. (Injuries and remedies); Grape Belt, June 26, p. 1, 6. (Habits of beetles, efficiency of destroying pupae, value of beetle catchers); Grape Belt, June 30, p. 4. (Beetles bred from two vines, efficacy of catchers); Grape Belt, Sep. 4, p. 1. (Brief summary of observations and experiments); same in Jamestown Journal, Sep. 4, p. 1; also in Country Gentleman, Sep. 24, 68:828; Grape Belt, Oct. 20, p. 1. (Results obtained by collecting beetles and spraying)

1903 **Slingerland, M. V.** Grape Belt, June 19. (Summary of present conditions)

1903 **Spencer, J. W.** Grape Belt. July 24. (Results with arsenate of lead)

EXPLANATION OF PLATES

Plate 1[1]

1 Beetle, much enlarged
2 Leaf badly riddled by the beetle
3 Eggs on last year's wood; the loose bark has been lifted so as to expose them
4 Larva or grub, much enlarged
5 Work of larva or grub on larger roots
6 Pupa or "turtle stage" in cell
7 Same much enlarged

Plate 2

1 Vineyard somewhat injured by Fidia, August 1903
2 Healthy vineyard with vigorous foliage, August 1903

Plate 3

Vineyard badly injured by the grapevine root worm. Observe that very few of the vines extend to the top wire. The wires and posts would ordinarily be concealed in a thrifty vineyard.

Plate 4

Vineyard more seriously infested than the preceding. A portion of this was uprooted last spring, and the area shown was kept simply for experimental purposes.

Plate 5

Portion of two vines represented on the preceding plate and showing how badly the beetles may eat the foliage when abundant.

Plate 6

Leaves from badly eaten vine, illustrating the peculiar, chain-like eaten areas

Plate 7

Breeding cages, distant view, showing also the general condition of the experimental area, June 1903

Plate 8

Breeding cages, near view, showing general condition of the vines near by, June 1903

---

[1] Executed from nature under the author's direction by L. H. Joutel.

Plate 9

Beetle catcher devised by Messrs Hough and Barden

Plate 10

Morehouse beetle catcher

Plate 11

Morehouse beetle catcher

Plate 12

Morehouse beetle catcher in operation, June 30

Plate 13

Blowers collecting machine

Plate I

L. H. Joutel, 1902

Grapevine root worm

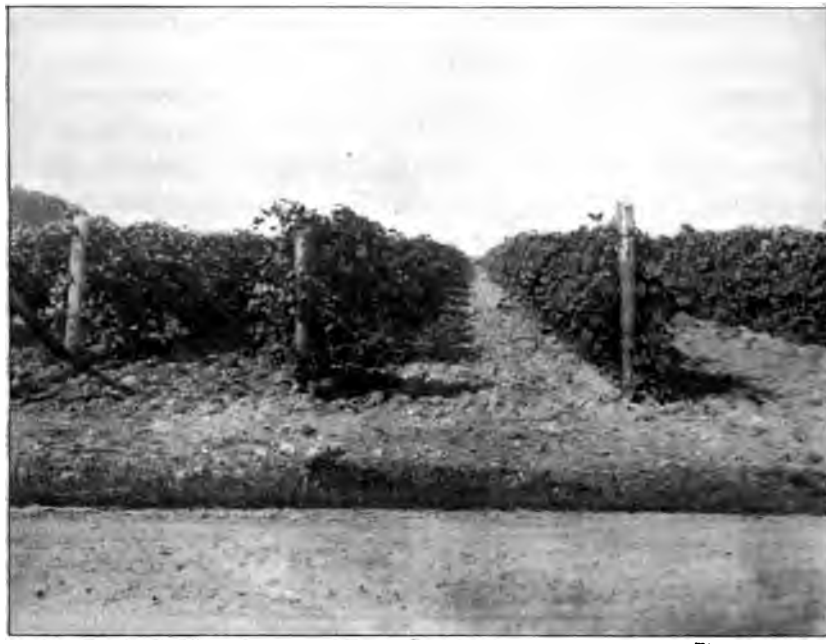


Photo August 1903

1 Vineyard somewhat injured by root worm

Photo August 1903

2 Healthy vigorous vineyard

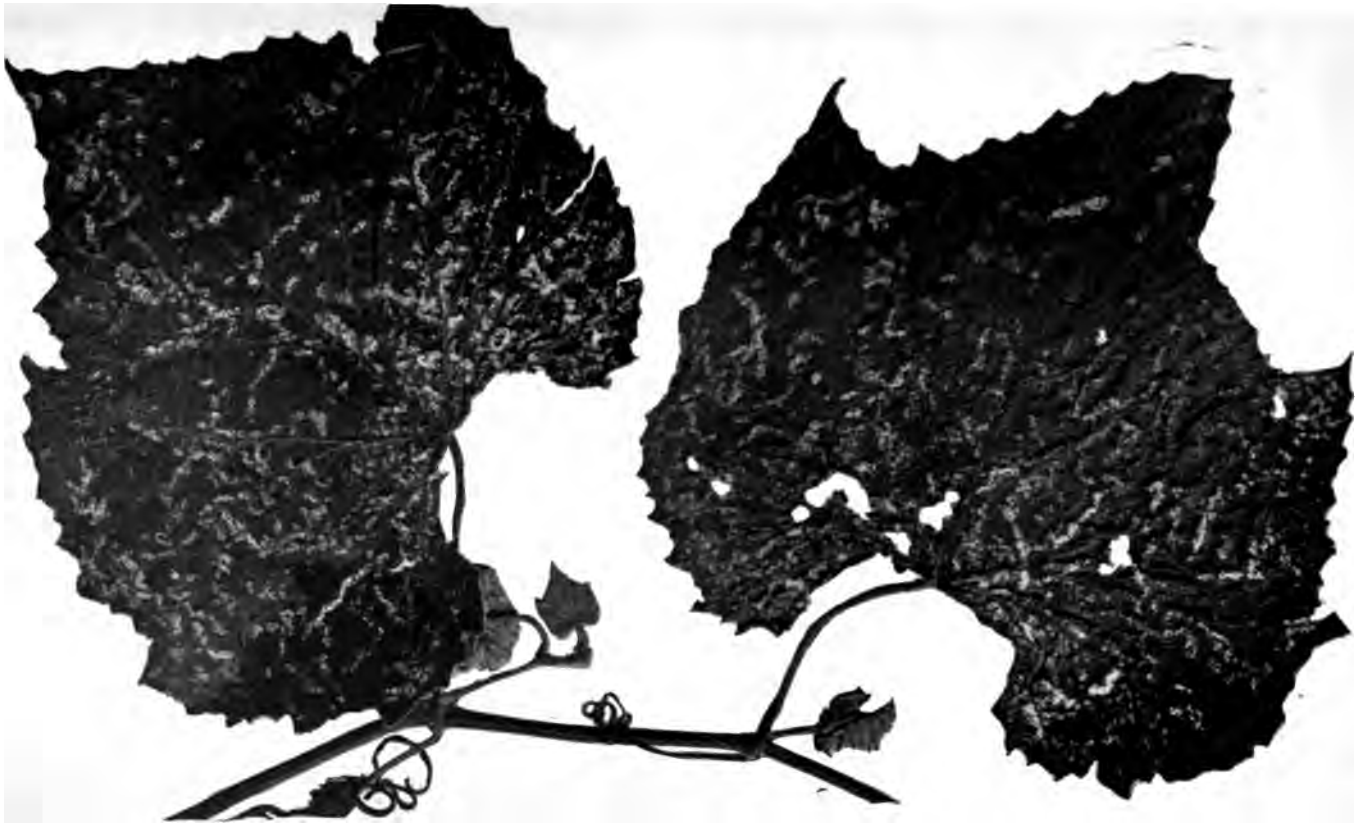
Photo Aug. 15, 1902

Vineyard badly injured by grapevine root worm (The vines should cover the wires and posts.)

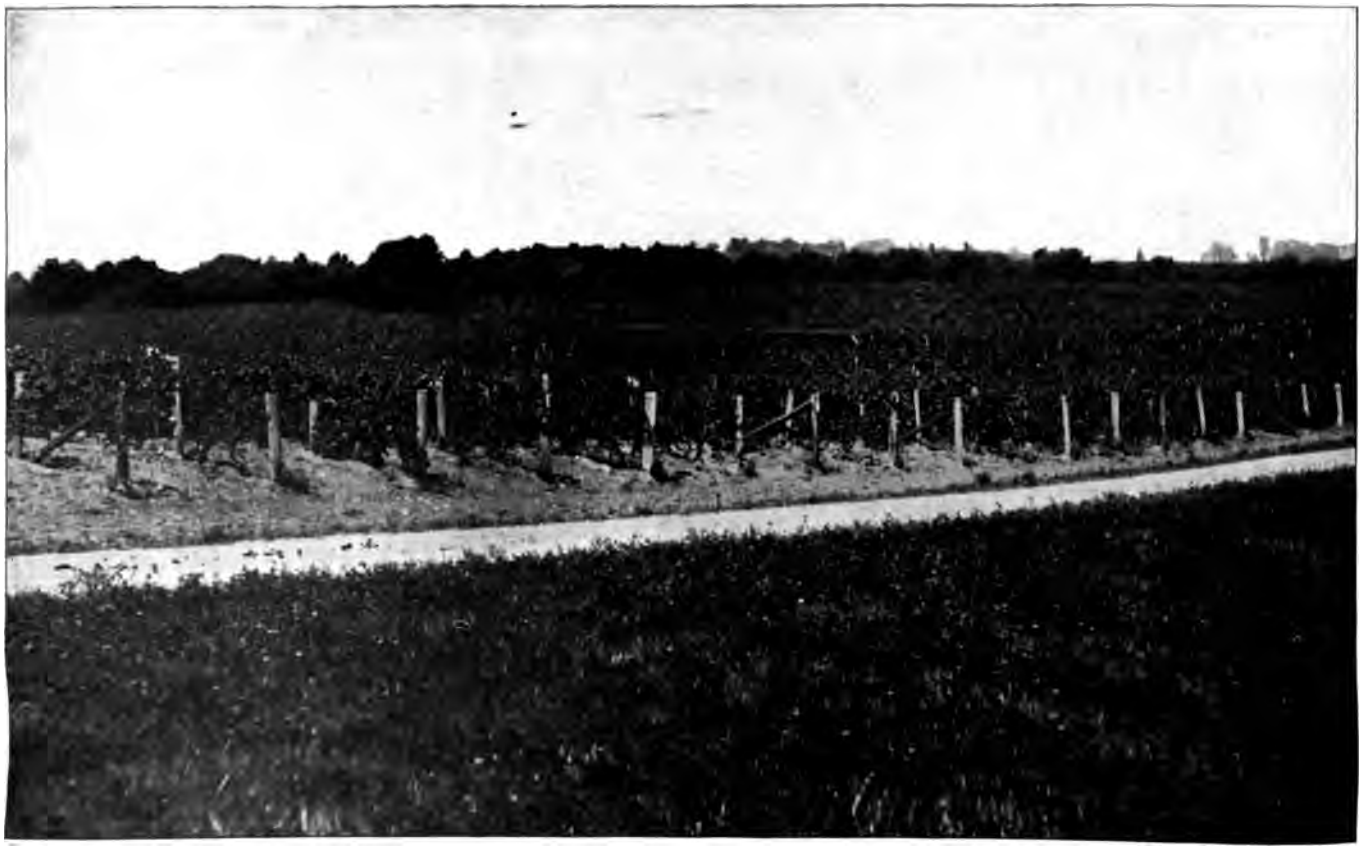
Photo Aug. 15, 1902

Vineyard very badly injured by grapevine root worm (This piece was torn out by the owner as worthless.)

Foliage badly eaten by beetles



Leaves from badly eaten vine, illustrating the peculiar chainlike eroded areas



Experimental vineyard and breeding cages near center

Photo June 1903

Photo June, 1903

Nearer view of breeding cages

Photo Aug. 15, 1902

Hough beetle catcher

Photo June 1903

Morehouse beetle catcher

Morehouse beetle catcher

Photo June 1903

Photo June 1903

Morehouse beetle catcher in operation

Blowers beetle catcher

Photo August 1903

INDEX

Albany, insect at, 8.
Ampelopsis quinquefolia, insect on, 8, 13, 30.
Ant, small brown, 32.
Aphis lion, 33.
arctata, Hoplophora, 32.
Arkansas, injuries at, 12.
Arsenical poisons, 11, 26, 29, 39–44.
asparagi, Crioceris, 8.
Asparagus beetles, 8.

Barden, J. Jay, services of, 3; observations, 16; on pupae, 25; spraying done by, 26; construction of machine for collecting beetles, 34.
Barden, William, destruction of eggs by, 44.
Beetle catcher, insects taken by, 29–30; efficacy, 36–38; Blowers, 38; Hough, 34–35; Morehouse, 35–36.
Bibliography, 47–49.
Bloomington Ill., injuries at, 12, 13, 43.
Blowers, R. S., beetle catcher, 38.
Bluffton Mo., specimens sent from, 11.
Bordeaux mixture, 11, 26, 29, 43.
botrana, Polychrosis, 31–32.
Brachysticha fidiae, 32.
Breeding cage experiments, 16, 27, 39–41.
Brightons injured, 10, 30.
brunneus, Lasius, *var.* alienus, 32.
Bunker Hill Ill., specimens from, 12.
Burgess, A. F., acknowledgments to, 4, 9; experiments by, 42.

Cage experiments, 16, 27, 39–41.
Calcium carbid, effect of refuse on grubs, 46.
Carabid beetle, 32.
Carbon bisulfid, 11, 45–46.
Catawbas injured, 10, 30, 31.
Cercis canadensis, 30.
chalybea, Haltica, 8
Chrysomelidae, 8.
Chrysopa *sp.*, 33.
Clymonts, T. S., statements on depredations in Ohio, 9; on spraying with bordeaux mixture, 11, 43; on cultivation, 45.
Collecting beetles, 3, 16, 34–39, 44, 47.
comes *var.* vitis, Typhlocyba, 5
Concords injured, 10, 30, 31, 41.
Crioceris asparagi, 8.
12-punctata, 8.
Crotch, G. R., description of insect, 12; cited, 47.
Cultivation of soil, time for, 33–34, 45, 47.
Curculio catcher, modified form, 34.

Dean, Clyde, vineyard, 23.
Diabrotica vittata, 8.
Dille, W. W., statements on depredations in Ohio, 10; cited, 48.
Disparene, 42.
duodecim-punctata, Crioceris, 8.

Egg parasites, 12, 32.
Egg stage, duration of, 23.
Eggs, 13, 16, 19; number laid, 20–23; destruction of, 44.
Elm leaf beetle, 8.
Experimental work in *1903*, 26–30.
Explanation of plates, 50–51.

Falvay, D. K., acknowledgments to, 3; vineyard of, 26, 31–32.
Felt, E. P., cited, 49.
Fidia longipes, 12.
lurida, 12.
murina, 12.
viticida, *see* Grapevine root worm.
fidiae, Brachysticha, 32.
Fidiobia flavipes, 32.
flavipes, Fidiobia, 32.
Food plants, 30.

Galerucella luteola, 8.
Grapeberry moth, 31–32.
Grapevine flea beetle, 8.
Grapevine leaf hopper, 5.

Grapevine root worm, allies, 8–9; beetles, time of appearance, 16; area infested, 6; beetles on canes, 17; depredations on poor soils, 7, 10; description, 13–14; early history, 11–13; eggs, 13, 19–23; duration of the egg stage, 23; experimental work in *1903*, 26–30; beetles feeding on upper surface of leaves, 17; flight of beetles, 18; food plants, 30; habits of beetle, 15–19; hibernation, 15; larva, 13; habits of larvae, 23–25; burrowing and traveling powers of larvae, 23; life history, 15–26; length of life, 16; a native species, 7–8; natural enemies, 32; present conditions in Ohio, 9–11; oviposition, 16–17, 19; in Portland, Westfield and Ripley, 5; prolificacy, 6, 20; pupa, 25; pupae easily destroyed, 25–26; will ruin a vineyard in two or three years, 5; signs of insect's presence, 6–7; tendency to remain in a locality, 18; preference for thrifty vineyards, 5; on wild grapevines, 7. *See also* Remedial measures.

Grapevines, soils, 7, 10; condition of the roots, 7; younger vineyards suffer most, 10; varieties affected, 30–31.

Haltica chalybea, 8.

Heteropus ventricosus 12, 32.

Highland, grapevine root worm in, 6.

Hoplophora arctata, 32.

Horn, G. H., record of distribution, 12; cited, 48.

Hough, G. L., vineyard, 23; on pupae, 25; construction of machine for collecting beetles, 34, 35; number of beetles collected by, 35.

Howard, L. O., statement of depredations, 13; cited, 48, 49.

Illinois, specimens from, 12; injuries at, 12, 13, 43.

Iowa City, specimen from, 12.

Kainit, 12.

Kentucky, specimens sent from, 11.

Kerosene emulsion, 46.

Kridelbaugh, S. H., cited, 47.

Lampe, J. L., vineyard, 43.

Larvae, described, 13–14; habits, 23–25.

Lasius brunneus *var.* alienus, 32.

Leaf hopper, 5.

Lefevre, Ed., insect described by, 12; cited, 47.

Life history, 15–26.

Lintner, J. A., examples of beetles in collection of, 8.

longipes, Fidia, 12.

Lugger, Otto, cited, 48.

lurida, Fidia, 12.

luteola, Galerucella, 8.

Mally, C. W., report of experiments, 12; mentioned, 43; cited, 48.

Marlatt, C. L., mentioned, 34; cited, 48.

Marx, George, mentioned, 32.

Maxwell, J. W., statements on depredations in Ohio, 10; on spraying, 43.

Milton, grapevine root worm in, 6.

Missouri, specimens from, 12; grapevine root worm in, 12.

Monfort, Frank, vineyard of, 41.

Montana, specimens sent from, 11.

Morehouse, F. A., estimates of damages, 5; observations, 16; improved form of catcher designed by, 35–38; trained chickens to eat beetles, 39.

Morse, vineyard, 42.

murina, Fidia, 12.

Murtfeldt, M. E., cited, 48.

Natural enemies, 32–33.

Neill, T. T., observations, 16.

New Jersey, distribution in, 13.

Newell, experiments by, 42.

Niagara vines, renewing a vineyard with, 10; injured, 30.

Northrop, Walter, estimates of damages, 5.

Ohio, present conditions in, 5, 9–11; evidence concerning efficacy of poisons in, 42–44.

Oviposition, 16–17, 19; experiments with Fidia, 20–23.

Paris green, experiments with, 39–40.
Parrott, Percy J., acknowledgments to, 4, 9, 42.
Petroleum, crude 46.
phylloxerae, Tyroglyphus, 32.
Plates, explanation of, 50-51.
Polychrosis botrana, 31-32.
Portland, grapevine root worm in, 5, 23.
Pulverizing the soil, 45.
Pupa stage, duration, 25.
Pupae, 14, 25; destroying the, 33-34.

Recommendations, 47.
Redbud, 30.
Remedial measures, 33-47; arsenical poisons, 11, 26, 29, 39-44; bordeaux mixture, 11, 26, 29, 43; carbon bisulfid, 11, 45-46; disparene, 42; effect of calcium carbid refuse on grubs, 46; collecting beetles, 3, 16, 34-39, 41, 47; destruction of eggs, 44; destroying the pupae 33–34; kainit, 12; kerosene emulsion, 46; paris green, 39-40; crude petroleum, 46; pulverizing the soil and mounding, 45; tobacco dust, 12; whale oil soap, 44; recommendations, 47.
Riley, C. V., cited, 11-12, 39, 47; on food plants, 30.
Ripley, grapevine root worm in, 5, 6, 18.

St Louis, specimens sent from, 11.
Schonfeldt, observations, 18.
Slade, W. H., statements on depredations in Ohio, 10, 31.
Slingerland, M. V., account of insect, 12; on collecting beetles, 34; cited, 48, 49.
Smith, J. B., cited, 12-13, 48, 49.
Spencer, John W., results obtained with arsenical spray, 41; cited, 49.
Spraying, *see* Remedial measures.
Squash bug, 8.
Staphylinus vulpinus, 32
Staten Island, injuries in, 13.
Stedman, suggestions, 38.
Stinson, J. T., injuries recorded by, 12; on use of poison in Arkansas, 43; cited, 48.
Stout, O. E., cited, 47.

Tobacco dust, 12.
Typhlocyba comes *var.* vitis, 5.
Tyroglyphus *sp.*, 32.
phylloxerae, 32.

ventricosus, Heteropus, 12, 32.
Vineland Ark., injuries at, 12
Virginia creeper, insect on, 8, 13, 30.
viticida, Fidia, *see* Grapevine root worm
vittata, Diabrotica, 8.
vulpinus, Staphylinus, 32.

Walker, C. M., assistance from, 4.
Walsh, B. D., specimens sent to, 11; cited, 30, 47.
Webster, F. M., discovery of grapevine root worm in Ohio, 9; account of investigations, 12; report of experiments, 12; on habits of beetle, 15; on feeding of beetles, 17; on number of eggs from a single vine, 19; on transparent band near each end of egg, 23; on habits of larvae, 23; on pupae, 25; on finding grubs in spring, 25; on enemies of grapevine root worm, 32; mentioned, 34; on efficacy of poisons, 42–43; on spraying with arsenate of lead, 43; on time for cultivation, 45; experiments with carbon bisulfid, 45–46; cited, 48, 49.
Westfield, grapevine root worm in, 5.
Whale oil soap, 44.
White fly, 5.
Wickham, H. F., specimen sent to, 12.
Wieting, C. A., acknowledgments to, 3.
Wordens injured, 10, 30, 31.

Young, D. B., assistance from, 4.

3 Clarke, J: M. The Oriskany Fauna of Becraft Mountain Columbia Co. N. Y. 128p. 9pl. Oct. 1900. *Sec.*

4 Peck, C: H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. *75c.*
This includes revised descriptions and illustrations of fungi reported in the 49th, 51st and 52d reports of the state botanist.

5 Clarke, J: M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. 196p. 21pl. July 1903 *$1 50, cloth.*

6 —— Naples Fauna in Western New York. *In press.*

Felt, E. P. Insects Affecting Park and Woodland Trees. *In preparation.*
Merrill, F: J. H. Geology of New York City and Vicinity. *In preparation.*
Ruedemann, Rudolf. Graptolites of New York. Pt 1 Graptolites of the Lower Beds. *In preparation.*

Natural history of New York. 30v. il. pl. maps. Q. Albany 1842-94.

DIVISION 1 ZOOLOGY. DeKay, James E. Zoology of New York; or, The New York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New York with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations. 5v. il. pl. maps. sq. Q. Albany 1842-44. *Out of print.*
Historical introduction to the series by Gov. W: H. Seward. 158p.

v. 1 pt1 Mammalia. 13+146p. 33pl. 1842.
250 copies with hand-colored plates.

v. 2 pt2 Birds. 12+380p. 141pl. 1844.
Colored plates.

v. 3 pt3 Reptiles and Amphibia. 7+98p. pt4 Fishes. 15+415p. 1842.
pt3-4 bound together.

v. 4 Plates to accompany v. 3. Reptiles and Amphibia 23pl. Fishes 79pl. 1842.
250 copies with hand-colored plates.

v. 5 pt5 Mollusca. 4+271p. 40pl. pt6 Crustacea. 70p. 13pl. 1843-44.
Hand colored plates; pt5-6 bound together.

DIVISION 2 BOTANY. Torrey, John. Flora of the State of New York; comprising full descriptions of all the indigenous and naturalized plants hitherto discovered in the State, with remarks on their economical and medical properties. 2v. il. pl. sq. Q. Albany 1843. *Out of print.*

v. 1 Flora of the State of New York. 12+484p. 72pl. 1843.
300 copies with hand colored plates.

v. 2 Flora of the State of New York. 572p. 89pl. 1843.
300 copies with hand colored plates.

DIVISION 3 MINERALOGY. Beck, Lewis C. Mineralogy of New York, comprising detailed descriptions of the minerals hitherto found in the State of New York, and notices of their uses in the arts and agriculture. il. pl. sq. Q. Albany 1842. *Out of print.*

v. 1 pt1 Economical Mineralogy. pt2 Descriptive Mineralogy. 21+536p. 1842.
8 plates additional to those printed as part of the text.

DIVISION 4 GEOLOGY. Mather, W: W.; Emmons, Ebenezer; Vanuxem, Lardner & Hall, James. Geology of New York. 4v. il. pl. sq. Q. Albany 1842-43. *Out of print.*

v. 1 pt1 Mather, W: W. First Geological District. 37+653p. 16pl. 1843.

v. 2 pt2 Emmons, Ebenezer. Second Geological District. 10+437p. 17pl. 1842.

v. 3 pt3 Vanuxem, Lardner. Third Geological District. 306p. 1842.

v. 4 pt4 Hall, James. Fourth Geological District. 22+683p. 19pl. map. 1843.

DIVISION 5 AGRICULTURE. Emmons, Ebenezer. Agriculture of New York; comprising an account of the classification, composition and distribution of the soils and rocks and the natural waters of the different geological formations, together with a condensed view of the meteorology and agricultural productions of the State. 5v. il. pl. sq. Q. Albany 1846-54. *Out of print.*

v. 1 **Soils of the State, their Composition and Distribution.** 11+371p. 21pl. 1846.

v. 2 **Analysis of Soils, Plants, Cereals, etc.** 8+343+46p. 12pl. 1849.
With hand-colored plates.

v. 3 Fruits, etc. 8+340p. 1851.

v. 4 Plates to accompany v. 3. 95pl. 1851.
Hand-colored.

v. 5 Insects Injurious to Agriculture 8+272p. 59pl. 1854.
With female colored plates.

DIVISION 6 PALEONTOLOGY. Hall, James. Palaeontology of New York. 8v. il. pl. sq Q. Albany 1847-94. *Bound in cloth.*

v. 1 Organic Remains of the Lower Division of the New York System. 23+338p. 99pl. 1847. *Out of print*

v. 2 Organic Remains of Lower Middle Division of the New York System. 8+362p. 104pl. 1852. *Out of print.*

v. 3 Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone. pt1, text. 12+532p. 1859. [*$3.50*]

—— pt2. 143pl. 1861. [*$2.50*]

v. 4 Fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 11+148+148p. 99pl. 1867. *$2.50*

v. 5 pt1 Lamellibranchiata 1. Monomyaria of the Upper Helderberg, Hamilton and Chemung Groups. 8+328p. 45pl. 1884. *$2.50.*

—— ——Lamellibranchiata 2. Dimyaria of the Upper Helderberg Hamilton, Portage and Chemung Groups. 62+293p. 51pl. 1885. *$2.50.*

——pt2 Gasteropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 2v. 1879. v. 1, text. 15+492p. v. 2, 120pl. *$2.50 for set.*

v. 6 Corals and Bryozoa of the Lower and Upper Helderberg and Hamilton Groups 24+298p. 67pl. 1887. *$2.50.*

v. 7 Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups. 64+236p. 46pl. 1888. Cont. supplement to v. 5, pt2. Pteropoda, Cephalopoda and Annelida. 42p. 18pl. 1888. *$2.50.*

v. 8 pt1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16+367p. 41pl. 1892. *$2.50.*

—— pt2 Paleozoic Brachiopoda. 16+394p. 84pl. 1894. *$2.50.*

Catalogue of the Cabinet of Natural History of the State of New York and of the Historical and Antiquarian Collection annexed thereto. 242p. O. 1853.

Handbooks 1893 date. 7½x12½ cm.
In quantities, 1 cent for each 16 pages or less. Single copies postpaid as below.

H5 New York State Museum. 52p. il. *4c.*
Outlines history and work of the museum with list of staff 1902.

H13 Paleontology. 12p. *2c.*
Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology; Relation to stratigraphy; History of paleontology in New York.

H15 Guide to Excursions in the Fossiliferous Rocks of New York. 124p *8c.*
Itineraries of 32 trips covering nearly the entire series of Paleozoic rocks, prepared specially for the use of teachers and students desiring to acquaint themselves more intimately with the classic rocks of this State.

H16 Entomology. 16p. *2c.*

H17 Economic Geology. *In preparation.*

H18 Insecticides and Fungicides. 20p. *3c.*

H19 Classification of New York Series of Geologic Formations. 32p. *3c.*

Maps. Merrill, F. J. H. Economic and Geologic Map of the State of New York; issued as part of Museum bulletin 15 and the 48th Museum Report, v. 1. 59x67 cm. 1894. Scale 14 miles to 1 inch. *Separate edition out of print.*

—— Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas form $3; mounted on rollers $5. Lower Hudson sheet 60c.*
The lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam, Westchester, New York, Richmond, Kings, Queens and Nassau counties, and parts of Sullivan, Ulster and Suffolk counties, also northeastern New Jersey and part of western Connecticut.

—— Map of New York showing the Surface Configuration and Water Sheds. 1901. Scale 12 miles to 1 inch. *15c.*

Published monthly by the
University of the State of New York
BULLETIN 321 JUNE 1904

AGRICULTURAL LIBRARY, UNIVERSITY OF CALIFORNIA

New York State Museum

Bulletin 74

ENTOMOLOGY 20

MONOGRAPH OF THE GENUS SAPERDA

BY

EPHRAIM PORTER FELT D.Sc.
State Entomologist

and

LOUIS H. JOUTEL

	PAGE
Preface	3
Genus Saperda of Fabricius	4
Subgeneric grouping	7
Bibliography	9
Distribution	9
Specific relationships	10
Systematic list of American species	13
Key to species	15
Grouping and summary of food habits of larvae	17
Saperda obliqua Say	18
mutica Say	21
hornii Joutel	22
candida Fabr.	23
Saperda calcarata Say	39
tridentata Oliv.	44
cretata Newm.	50
discoidea Fabr.	52
vestita Say	54
imitans n. sp.	58
lateralis Fabr.	59
fayi Bland	62
puncticollis Say	66
populnea Linn.	68
moesta Lec	71
concolor Lec	73
Explanation of plates	76
Plate 1-14	face 80
Index	81

ALBANY
UNIVERSITY OF THE STATE OF NEW YORK
1904

Mes05m-Se-sc00

Price 25 cents

University of the State of New York

REGENTS

With years when terms expire

1913 WHITELAW REID M.A. LL.D. *Chancellor* – New York
1906 ST CLAIR MCKELWAY M.A. L.H.D. LL.D. D.C.L.
Vice Chancellor, Brooklyn
1908 DANIEL BEACH Ph.D. LL.D. – – – Watkins
1914 PLINY T. SEXTON LL.D. – – – – Palmyra
1912 T. GUILFORD SMITH M.A. C E. LL.D. – – Buffalo
1905 ALBERT VANDER VEER M.A. Ph.D. M.D. – Albany
1907 WILLIAM NOTTINGHAM M.A. Ph.D. – – – Syracuse
1910 CHARLES A. GARDINER LL.B. M.A. Ph.D. LL.D. New York
1915 CHARLES S. FRANCIS B.S. – – – – Troy
1911 EDWARD LAUTERBACH M.A. – – – – New York
1909 EUGENE A. PHILBIN LL.B. – – – – New York

COMMISSIONER OF EDUCATION

1910 ANDREW S. DRAPER LL.D.

University of the State of New York

New York State Museum

FREDERICK J. H. MERRILL Director
EPHRAIM PORTER FELT State Entomologist

Bulletin 74

ENTOMOLOGY 20

MONOGRAPH OF THE GENUS SAPERDA

PREFACE

In the preparation of this paper all the original descriptions of the various species have been carefully examined, and as many of the types as were in this country have been studied. Most of our species are so well marked that there was little trouble in identifying them, and only tridentata and forms of populnea presented difficulties. The first mentioned has a species which resembles it very closely, and the question was, which had been described by Olivier. The original description was so vague that it applied equally well to either; but fortunately Olivier had figured the form described, and this proves beyond doubt that our common eastern borer of the elm is his species. Several forms, which could not be referred to any of our species, were found, one of which presented all the characters of the European populnea, and there is no doubt that it has long been established in California, Oregon, Washington and British Columbia, having evidently made its way into this country through Alaska.

The writers take great pleasure in acknowledging assistance from the following gentlemen: Dr Henry Skinner and Mr H. W. Wenzel, who employed their kind offices in procuring the loan of specimens from the collections of the American Entomological Society and afforded facilities for the study of material in the Horn collection, Mr Samuel Henshaw of the Museum of Comparative Zoology, who

granted the privilege of studying the LeConte and other collections at Cambridge, Dr H. G. Dyar, who procured the loan of material from the National Museum, Mr E. A. Schwarz, who furnished facilities and aid in studying the collections at Washington, and also the following gentlemen, who rendered various services, Messrs Charles Schaeffer, Frederick Blanchard, F. C. Bowditch, Germain Beaulieu, H. G. Klages, Charles W. Leng, C. V. Piper, W. S. Marshall, J. J. Rivers, Charles Fuchs, Dr D. M. Castle, E. D. Harris, Philip Laurent, F. E. Watson, C. W. Woodward, H. C. Fall, William T. Davis, C. J. S. Bethune, F. M. Webster, Charles Palm, W. Knaus, A. F. Winne, Dr R. E. Kunze, Charles Stevenson and C. J. Oeillet. Dr Henry C. Van Dyke kindly contributed notes on localities of h o r n i i, and a number of New York collectors kindly allowed us the privilege of examining the material in their collections.

The junior author has collected members of this genus for a number of years and has made many trips about New York city to secure their workings, often in the company of his friend, William T. Davis, who took much interest in securing desirable specimens. All of the species have been bred but the typical p o p u l n e a, m u t i c a, h o r n i i and c r e t a t a, though we have had workings of the latter.

The junior author has undertaken the illustration and systematic study of the species; while his associate has studied the insects more particularly from an economic standpoint and has summarized the literature and compiled the bibliographies.

GENUS SAPERDA OF FABRICIUS

This genus is one of great economic importance, since it contains two species which are very injurious to appletrees and another which may possibly acquire this habit. One species is known as being very destructive to the American elm, one often seriously injures hickory, another sometimes destroys large numbers of our lindens, and a fourth is exceedingly injurious to poplars; the latter are also attacked by several other species of the genus.

This group is also of interest to the systematic student, since it shows in a limited number of species great divergence and specialization from a common type. Much confusion has hitherto existed concerning the identity of our western species, and this was only partly

cleared up by the characterization of h o r n i i. Our study has brought out the interesting fact that, among the so called western forms of m o e s t a, one is identical with the European p o p u l n e a, and can not be differentiated in any particular from that species. We find that two species have been included under the name t r i d e n t a t a, as well as a distinct variety of l a t e r a l i s. All but three American species occur in New York State, and our study has on that account been monographic.

Series of all American species have been examined, and several characters not noted or seen by former students have been found. The European and Asiatic species have all been studied, except a few Siberian forms which are probably only varieties. Since both sexes were not obtainable of all the exotic forms, it has not been possible to include a discussion of them in this paper. They are mentioned wherever it is necessary to show the close relationship existing between the two faunas.[1] The 13 species and one variety listed by Samuel Henshaw in 1885 have been increased by us to 15 species and five subspecies or varieties.

The species are so closely related, though differing greatly from each other in several characters, that subdivision of the genus is not considered advisable and would not be practicable, as whatever characters might be used, disappear so gradually that the species could not be as well arranged as in the present grouping, and it would tend to bring widely separated forms close together.

The exotic species have been divided into a number of genera and subgenera on characters which we consider, from our studies of the entire group, degrees of specialization.

Mr Mulsant divided the European species on the relative size of the metathoracic episterna, the form of elytra and on the antennae

[1]In studying the two faunas together, the indications are very strong that they were derived from common ancestors; and, while the two are quite distinct in many ways, they have evidently specialized along different but parallel lines, and their characters are intermediate.

The fact that the American species are all of eastern origin (except those few that show their immigration into the Pacific fauna through Alaska) and the Old World ones of western origin would tend to show that at some remote epoch there was a connection between the two continents.

being annulated or not. Species not closely related to each other occur in his subgenera, as they do in any other attempt to divide them. His genera are not now generally recognized. The Asiatic species have been placed in several genera. The genus Thyestes erected by Mr J. Thomson for a Japanese species has no character not found in one or the other of our Saperdas; and we consider his species pubescens allied to puncticollis with some characters also of lateralis; and its annulated antennae connects it with the more highly specialized ones. Another point that shows its close relation to puncticollis is the possession of a process on the anterior claw of the middle pair of legs only; and the form of this process also resembles that of puncticollis. Another genus, Eutatrapha, has been erected by Bates for those Asiatic species with the sides of the elytra carinated. We consider this character a sign of specialization and not of generic value, as we find it in an advanced rudimentary state in our tridentata, where it is not equally marked in all specimens. It is formed by the arrangement of the punctures and is quite different in appearance from the extreme form found in Eutatrapha (Saperda) metallescens. Eutatrapha (Saperda) 16-punctata and varicornis (S. carinata) have this character also, but not so strongly marked. It can be traced in some other of our species, as S. discoidea ♂ and S. hornii, where a straight line of punctures, more or less pronounced in different examples, shows the most primitive form of this character; and its entire absence in some individuals of discoidea robs it of any generic value it seems to possess in its more highly specialized form. To show the slight value of this and other characters taken separately, we would call attention to Paraglenea fortunei from China, which has the elytra carinated and has both claws of all the legs armed with a spine as in lateralis. It is closer to Saperda than any other genus. Glenida suffusa has the elytra carinated but lacks the process on the claws, and is only distantly related to Saperda. Several other genera were desired for study but material was not obtained in time for this bulletin. The males of metallescens have

the claws armed as in tridentata. Males of the other carinated species were not obtained. Should this genus be accepted our S. tridentata would be included in it.

Subgeneric grouping. One character that could be used for a subgeneric division is the presence or absence of the process[1] on the claws of the males. Though we consider this character of little value except to show the relation of the species and really a sign of specialization and not of much generic importance, as its occurrence in genera[2] not very closely related to Saperda shows, its use as a basis of division would group the species as follows.

Group 1	Group 2	Group 3	Group 4
Process on anterior claw of front and middle tarsi	Process on both claws of all tarsi	Process on anterior claw of middle tarsi	Process wanting
obliqua mutica hornii candida calcarata tridentata cretata discoidea vestita imitans fayi	lateralis	puncticollis	populnea and its forms concolor

[1]LeConte and Horn, in their classification of the Coleoptera of North America, make the erroneous statement that this process is wanting in the European species. It is however very prominent in carcharias, punctata, 8-punctata and probably in others of which we did not see males. Lacordairé, in *Genera of Coleoptera*, also seems to imply that it is wanting in the European species. LeConte, in *New Species of North American Coleoptera*, part 2 [Smithsonian Miscel. Coll. 264. 1873. p.239] overlooks the process on the claw of the middle tarsi of puncticollis and the armature of all the claws of lateralis. Subsequent authors have committed the same errors.

[2]In the species of Thyestes which we have seen, the males are armed as in puncticollis. The males in the genus Eutatrapha are armed as in the first group. Those of Paraglenea fortunei are like those of lateralis. The males we have seen of the European species group as follows. To the first group belong carcharias, punctata, 8-punctata, and to group 4 populnea and scalaris. The males of the other species we were not able to obtain.

This grouping separates populnea and concolor from the closely allied mutica and hornii, and brings together some that are not so closely allied, but it shows fairly well the degree of specialization of the species, as will be shown later.

If our species only are considered, a more natural grouping can be made on antennal characters, the species having annulated antennae being more closely related to each other than to those with unicolorous ones; but, when the foreign species are taken into account, this character loses its value, as we find S. perforata and some of the species that have been referred to Eutatrapha and Thyestes with the antennae annulated, though the other characters would lead us to look for unicolorous ones, they being very close to our tridentata and but distantly related to the species this character would place them with. Using the antennae, the species would divide as follows.

Antennae annulated	Antennae unicolorous
obliqua	candida
mutica	calcarata
hornii	tridentata
populnea	cretata
moesta	discoidea
tulari	vestita
concolor	imitans
	fayi
	lateralis
	puncticollis

The foreign species, carcharias, scalaris, perforata, similis, quercus, Eut. varicornis, 10-punctata and T. pubescens would come in the first group; the others in the second group.

The development of the head usually follows that of the process on the claws; but there are exceptions to this rule, as is seen in the case of scalaris of Europe, where the flat front of the head would place it near calcarata instead of with populnea, where it more naturally belongs. In fact, whatever character is taken, it

will be found to be unevenly developed in its relation to the others possessed by the species.

Other characters such as elytral form, shape of thorax and abdomen, etc., seem from our studies to have little if any constant value in grouping the species, as, when they are used, species are brought together that have very little direct affinity with each other.

Bibliography

1781 **Fabricius, J. C.** Sp. Ins. 1:230 (Genus erected)
1787 ——— Mantissa Ins. 1:147 (Genus characterized)
1792 ——— Ent. Syst. 1:307 (Genus characterized)
1801 ———Syst. Eleu. 2:317 (Genus characterized)
1854 **Emmons, E.** Nat. Hist. N. Y. Agric. 5:119 (Habits, injuries etc.)
1873 **LeConte, J. L.** Class. Coleopt. pt 2. Smithsonian Miscel. Coll. 265, p.345-46 (Tribal characters)
1873 ——— New Sp. N. Am. Coleopt. pt 2. Smithsonian Miscel. Coll. 264, p.238-39 (Table of species)
1874 **LeBaron, William.** Noxious and Beneficial Ins. Ill. 4th Rep't, p.158, 159 (Table for separation of genus, no species)
1877 **Thomas, Cyrus.** Noxious and Beneficial Ins. Ill. 6th Rep't, p.37 (Larval characters of Lamiides)
1877 **Provancher, *L'abbé* L.** Faune Ent. Can. Coleopt., p.632 (Genus and table of species)
1883 **LeConte, J. L. & Horn, G. H.** Class. Coleopt. Smithsonian Miscel. Coll. 507, p.331 (Characters of tribe)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:325 (Generic characters)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:146-47 (Table of species)
1898 **Wickham, H. F.** Can. Ent. 30:40-42 (Reproduces Dr Hamilton's table of species given in Am. Ent. Soc. Trans. 23, notes on food plants)

Distribution. The genus is confined to the temperate parts of the northern hemisphere. The distribution of some of the species is somewhat erratic, and all but three American forms appear to have originated in the East and occur in the State of New York. Our common calcarata, found through the East and Middle West, also occurs in Texas as well as the state of Washington, and has been recorded from intervening territory. On the east coast tridentata has much the same range and is likewise found in Texas, but not in the northwest. Obliqua, candida, cretata, fayi, vestita, discoidea, lateralis,

puncticollis and moesta have about the same range, being found in Canada, in the eastern states and also in the Middle West. The typical populnea is found only on the Pacific coast, tulari occurs in the same localities and also in Colorado and Arizona. Concolor is found in Arizona and Colorado. The variety unicolor has the same general range as moesta. Hornii is confined to the western coast from Los Angeles Cal. to British Columbia.

Specific relationships. Before attempting to group the species according to their natural affinities, a few remarks on their specific characters may be of interest. The antennae of most species are unicolorous. In some, obliqua, mutica, hornii, populnea, moesta, tulari and concolor and its variety, they are more or less annulated with gray, (brown and black in obliqua), and two of these species have the first joint enlarged. The length of the antennae also varies in the different species, being very short in mutica.

The shape of the last segment of the female abdomen presents an excellent character for the separation of some species. The pygidium of some is broad with the apex blunt and in others it is long. The tip may be more or less divided into two lobes, the upper surface may be either marked by a median depression or may be convex as in mutica.

The angle formed by the sides varies in different species. The front claws of the anterior and middle tarsi of the males are armed with either a blunt process or tooth, which is lacking on the front pair in puncticollis, wanting on all claws in populnea, moesta, tulari and concolor and present on both claws of each pair of legs in lateralis. This process is subject to variation as to size and form in individuals of the same species, and it has been used as a specific character as little as possible. The shape of the thorax, whether cylindric or narrowed in front, affords a good character. The form of the apex of the elytra is of value in determining species, as they may be rounded, obliquely narrowed, armed with a spine or truncate. The shape of the head

and eyes varies greatly in different species. The punctures of some species are quite constant; but in others, populnea, moesta, tulari, they vary so much that little dependence can be placed on them. The species range in size from calcarata, which is from ⅞ to 1⅛ inch long, to populnea ⅜ inch in length, but occasional specimens may be much smaller than the normal. The color and markings are quite constant, and only lateralis shows marked variations. Calcarata has a variety, adspersa, which is entirely brown. The legs of most species are black, covered with a gray pubescence, yellow in vestita; those of obliqua, cretata and discoidea are reddish brown with gray pubescence.

Arrangement indicates the degree of specialization. The salient characters of the various species having been given, it now remains to use them in a natural grouping of the forms. It is very apparent that the usual arrangement is arbitrary and based almost entirely on color and markings. It is not to be supposed that the following grouping means that the species are derived or descended from each other. It represents simply our idea of the degree of removal or specialization from an ancestral type and is based on a study of characters of unequal value. It is very evident that our own species have specialized along different lines and have probably originated from several type forms.

The least specialized of our native species is evidently concolor, since it is unicolorous, has no striking characters and presents fewer differences from its nearest allies in other genera, than any of the other species. It has no process on the claws of the male and the rather few elytral punctures are merely shallow depressions without definite edge and are punctate like the remainder of the elytra. The species diverging most widely from it, and therefore the most specialized, is obliqua, since it has characters not possessed by any of the others. It has the elytra separately narrowed and armed with a spine. The thorax is narrowed in front, and the head is small, and deeply impressed between the eyes. The annulated antennae have the first joint swollen and dark, and the elytra are embossed to match the color pattern. The process is very highly

specialized as can be seen by reference to figure 3. The species which possesses the greatest number of these characters is mutica. It is true that it lacks the spine at the apex of the elytra, but it has the narrowed thorax, small head and the antennae with an enlarged, dark basal joint. These two species form a group by themselves closely approached by hornii (which is nearly related to the European similis); it has the annulated antennae, but the first joint is normal and the thorax is nearly cylindric, in some specimens entirely so. The color and maculation are much like those of mutica. We then come to the European carcharias, with its narrowed thorax and annulated antennae. The humeral angles are quite prominent and the elytra tapering. The nearest American representative is candida, an insect which at first would not seem to belong here, but that is due more to the color and markings, characters of the smallest value, since, if we omit the color from consideration, we shall find that the shape and structure are very similar to carcharias, as represented by the narrowed thorax, small head, prominent humeral angles and tapering elytra. The unicolorous antennae show candida to be less specialized than this European species. Calcarata, our next species, is also somewhat related to carcharias and leads naturally to tridentata, which is of the same general shape and has in addition the elytra truncate and weakly sinuate at tip, evidently an early stage of the sutural spine found in calcarata. Tridentata has a character (a submarginal carina beginning at the humeral angle and continuing to the apex) not present in any other of our forms, but which, strange to say, has its counterpart in some old world species.[1]

The remaining species appear to follow in regular order as given in Henshaw's list, except that fayi would more naturally follow lateralis, since it has the rounded head possessed by the species that follow and the same gall-making habit. The spine on its front claws is very small and rudimentary, approaching the condition of

[1]This character is made use of by Bates to form the genus Eutatrapha, to which he refers 16-punctata, varicornis and metallescens. It would also include tridentata. [*See* p. 6]

puncticollis, where it is entirely absent. Imitans is close to lateralis and fayi and presents more characters in common with the last than with tridentata, though its markings are much like the latter.

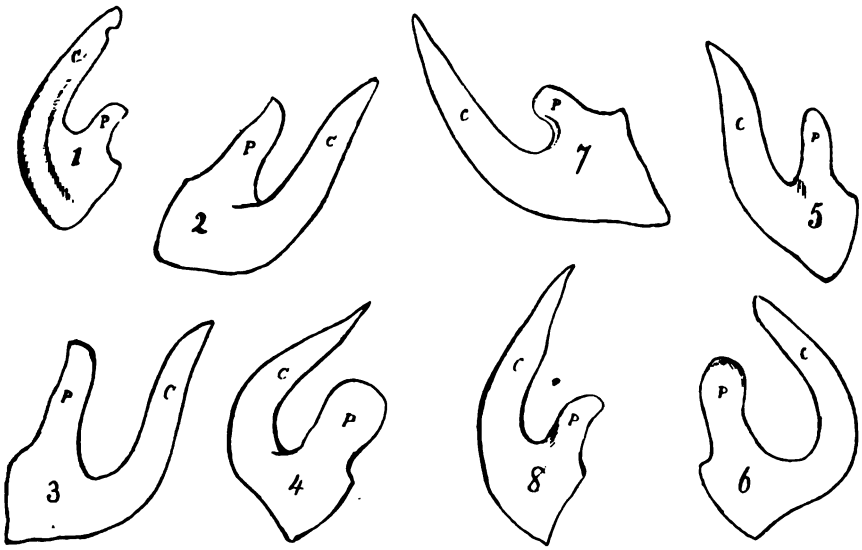


Fig. 1 Front claw of first and middle tarsi of the following species: 1 and 2, Saperda imitans; 3 and 4, Saperda tridentata; 5 and 6, Saperda discoidea; 7 and 8, Saperda vestita. C= claw, P= process.

Systematic list of American species of Saperda

obliqua *Say*
mutica *Say*
hornii *Joutel*
candida *Fabr.*
calcarata *Say*
var. adspersa *Lec.*
tridentata *Oliv.*
cretata *Newm.*
discoidea *Fabr.*
vestita *Say*
imitans *n. sp.*
lateralis *Fabr.*
var. connecta *n. var.*
fayi *Bland.*
puncticollis *Say*
populnea *Linn.*
subsp. moesta *Lec.*
subsp. tulari *n. subsp.*
concolor *Lec.*
var. unicolor *n. var.*

The development of the process on the claws follows the foregoing arrangement better than any other, and we find that the degree of development is somewhat different from published accounts of earlier workers, who probably lacked sufficient material.

Process moderate on anterior claw of front and middle tarsi: obliqua, mutica, hornii, candida.

Process long on anterior claw of front and middle tarsi: calcarata, tridentata, cretata.

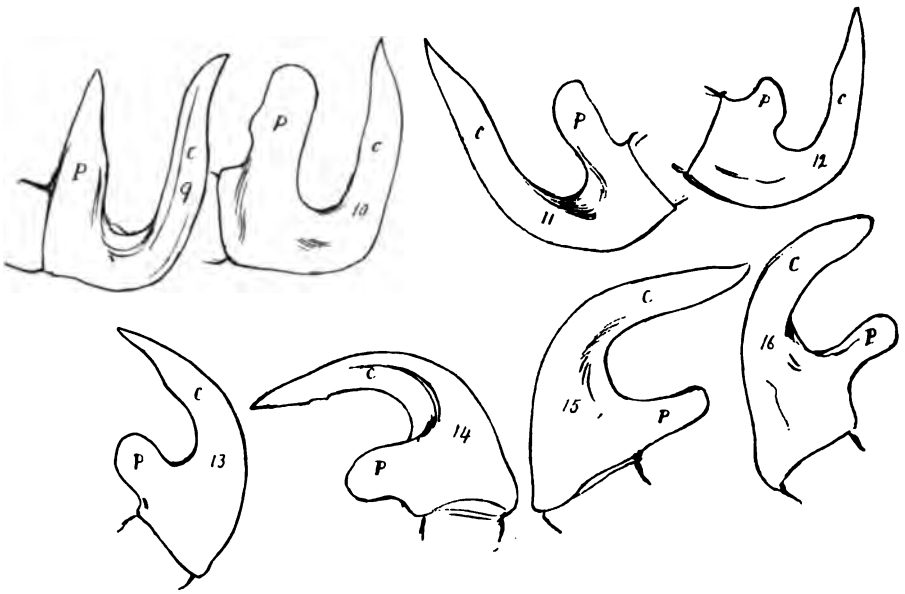


Fig. 2 Front claw of first and middle tarsi of the following species: 9 and 10 Saperda cretata; 11 and 12 S. candida; 13 and 14 S. hornii; 15 and 16 S. calcarata. C= claw, P=process.

Process shorter on anterior claw of front than middle tarsi: discoidea, vestita, imitans.

Process small on both claws of all tarsi: lateralis.

[1] Process very small on anterior claw of front and small on middle tarsi: fayi.

Process wanting on front and large on middle tarsi: punctipollis.

Process wanting: populnea, moesta, tulari and concolor.

[1] As this process shows considerable variation in shape and size in different specimens of the same species, we have taken the most common shape and size as the normal for each species.

Key to species

a Antennae plainly annulate

b Head deeply impressed between the eyes

c Antennae with first joint normal and gray..... hornii

cc Antennae with first joint enlarged and dark

d Elytra obliquely narrowed, ending in a spine at the tip ..... obliqua

dd Elytra slightly narrowed and without a spine..... mutica

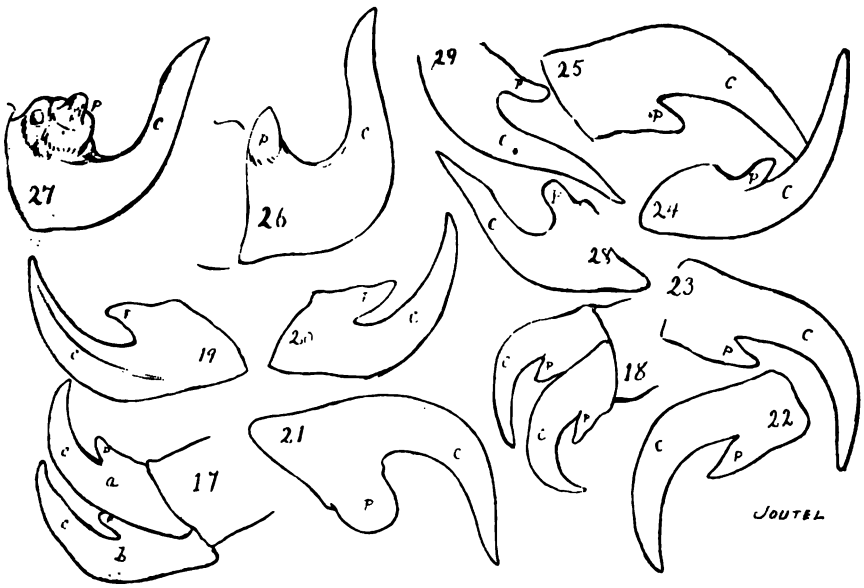


Fig. 3 Claws of following species: 17 Both claws of front tarsi of S. lateralis; 18 Both claws of middle tarsi of S. lateralis; 19 Front claw; 20 Posterior claw of middle tarsi of S. lateralis; 21 claw of middle tarsi of S. puncticollis; 22 and 23 Claws of hind tarsi of S. lateralis; 24 and 25 Claws of front and middle tarsi of S. fayi; 26 and 27 Claw of front and middle tarsi of S. obliqua; 28 and 29 Claw of front and middle tarsi of S. mutica.

bb Head rounded in front

c Antennae with first joint black and normal in size

d Upper side strongly punctate and confluent with few punctulations between, sparsely covered with gray or light fulvous hairs, several spots of dense yellow or fulvous hair on elytra; fulvous stripe on side of thorax..... populnea

dd Upper side with punctures not so numerous, and sparsely covered with gray hairs, unicolorous, punctulations on intervals more numerous; light stripe on thorax nearly obsolete ..... subsp. moesta

ddd Upper side with fewer but larger and deeper punctures, more densely punctulate on the intervals and densely covered with red or fulvous hairs; thorax with stripe on sides and top ..... subsp. tulari

dddd Upper side finely punctulate and with small shallow punctures and uniformly covered with a dense layer of light gray or yellowish gray hairs; thorax with lateral stripe
concolor

e Punctures much more numerous, hair dirty gray; lateral stripe wanting or nearly so.....var. unicolor

aa Antennae unicolorous

b Elytra rounded with spine at suture

c Gray with yellow patches.....calcarata

cc Color uniform fulvous.....var. adspersa

bb Elytra with marginal or submarginal stripe

c Thorax and elytra brown or yellowish brown with two white stripes; under side white.....candida

cc Thorax yellow with four black spots on dorsum and one on each side; elytra bordered with bright yellow with a black spot in front; under side gray.....puncticollis

ccc Thorax and elytra gray and with an orange red lateral stripe

d Second and third cross bands on elytra oblique, a dark spot usually on each side of the first and one behind the third; front of head very flat; elytra more or less truncate
tridentata

dd First and second cross bands on elytra oblique; front of head flat; elytra rounded at apex.....imitans

cccc Thorax and elytra black

d Sutural and lateral stripe on elytra orange red; head somewhat rounded; under side gray.....lateralis

dd Sutural stripe usually wanting and with one to three cross bands; lateral band reaching to margin; under side gray
var. connecta

bbb Elytra with spots, rarely concolorous

c Cinnamon brown with a white stripe on each side of the thorax

d A large white spot in center of each elytron and a smaller one near its apex, neither reaching to margins; sides and under surface white .....cretata

dd White stripe on thorax continuing on elytra at humeral angles; the elytra with two white spots, one at the middle, the other near the apex and almost sutural; sides and under surface white; the spots are more or less obsolete in the male..fayi

cc Cinnamon brown, sometimes nearly black, with a transverse, undulate, yellowish olive fascia across the middle of the elytra; sometimes with an additional spot both before and behind this fascia; thorax and apex of elytra and scutellum olive; legs light reddish, under side lighter.....discoidea♀

ccc Uniformly reddish brown, sometimes black; legs reddish; under side lighter.....discoidea♂

cccc Olive yellow with three denuded black spots on each elytron, some or all occasionally wanting.....vestita

Grouping and summary of the food habits of the larvae

The larvae of this genus may be divided by their food habits into three classes: (1) those that bore in the large branches and trunks of living trees and feed on the sap, calcarata, candida, cretata, vestita and possibly hornii and mutica; (2) those that live in small branches and usually produce galls, subsisting on sap, and not making the extended galleries of the first group, fayi, populnea, obliqua, concolor; (3) those that feed on living and dead tissues of dying or recently killed trees, tridentata, discoidea, lateralis, imitans and puncticollis. The manner of feeding and the portion of the tree attacked vary with different species, and most of the forms have special food plants.

S. obliqua feeds close to the ground at the collar of the black alder, where it often entirely girdles the stem, forming a knot or gall and ultimately killing it; and, when not entirely girdled, the tree is so weakened that the stem soon breaks. A walk through an alder swamp where this insect is common will show a great number of prostrate stems in all stages of decay.

S. mutica. This species is said to live on the willow and is the only eastern form that we have not bred and of which we have been unable to secure workings.

S. hornii feeds on the willow according to Dr H. C. Van Dyke, who has taken the insect on that plant.

S. candida is usually very common in apple and attacks several allied trees. It is quite destructive to seedlings and young trees, where it works at the base of the trunk and roots, and, as several generations follow in the same wound, the tree is soon killed.

S. calcarata works in the trunk and larger branches of the silver poplar in particular and soon kills the trees. It is surprising to see the quantity of sawdust around a badly infested tree, thrown out by the larvae when making their pupal chambers.

S. tridentata works in and under the bark of the trunk and branches of the elm, and has also been recorded in other trees.

S. cretata lives in the thorn and apple, usually in the trunk and larger branches, and works somewhat like S. calcarata, but the burrow is longer and more tortuous.

S. vestita attacks the linden and in our experience works mostly at the base and roots. We have never found it more than 12 inches from the ground, and that seldom. It can always be found in exposed roots and at the base of the tree close to the ground. In either case the larvae usually work in the subterranean parts. Prof. F. M. Webster has also noted this habit.

S. discoidea lives under and in the bark of hickory, specially dying trees or those recently killed by Scolytus quadrispinosus Say. It can be easily bred from a piece of dead bark.

S. imitans is not known in its early stages but probably bores in hickory and not in elm.

S. lateralis works in hickory at some injured place near the root and is partial to the base of sprouts that grow around stumps on recently cleared land.

S. fayi makes a gall very simlar to that of concolor, but breeds in the thorn.

S. puncticollis works in the dead branches of Virginia creeper, eating the inner bark and pupating in a chamber excavated in the wood.

S. populnea feeds on the willow and poplar. S. moesta makes a gall on the balm of gilead, and this, we believe, is its only food plant, and the form tulari lives in willow.

S. concolor makes a gall on poplar and willow shoots.

Saperda obliqua Say

Alder borer

This species, while rarely met with in the adult form, appears to be very common in New York State, judging from the condition of some of the alder swamps we have visited.

Life history and habits. This insect's method of working is quite characteristic [pl. 5, fig. 3], and the badly girdled stems with gall-like enlargements, are not difficult to find. The insect works close to the ground in black alder, frequently girdling the trunks, and in infested swamps large numbers of prostrate stems in all stages of decay may be found. There are usually two or three

borers in each trunk, one of which is very apt to work downward to the depth of 3 or 4 inches and often below the ground level and the others in an opposite direction. The young grubs bore just beneath the bark, much like those of S. candida Fabr., and the nearly full grown individuals work near the center of the stems and not infrequently fairly riddle the base, causing it to break in the wind. In fact, the general method of work is very similar to that of the round-headed appletree borer, and the perfect insect emerges from a hole very similar to that made by the species infesting the apple.

The beetle [pl. 5, fig. 6] is generally found near the top of alder branches. Mr Fred Knab, of Chicopee Mass. states that it easily escapes notice on account of its great resemblance to a withered leaflet. He adds that it differs from others of its genus, which are also shy insects, in that it remains perfectly motionless, clinging tightly to the branch and with the antennae extended forward. He has also found this insect on birch. Dr Packard records the beetle as occurring on alder; Dr Smith states that it is rare throughout New Jersey, where it breeds in black alder; and the late Dr Lugger records it as breeding in hazel shoots.

Distribution. This species was described by Say from Missouri; it has been collected about Buffalo by Zesch-Reinecke; Dr Smith records it from New Jersey; and Dr LeConte from Pennsylvania. The following localities for this species have been given by Messrs Leng and Hamilton: Wisconsin, Mississippi, Canada, Massachusetts, New York, New Jersey, Pennsylvania and Missouri. It has been found in various localities about New York city, such as Bronx park, Fort Lee and Staten Island and has also been recorded from Alabama and Montreal. We have seen specimens taken in Illinois in the Bolter collection.

Description. Light reddish brown with darker bands; antennae annulate, with the first joint dark and swollen; thorax narrowed in front; a dorsal stripe of darker brown continuing on the head; a subdorsal stripe that converges and continues on

the elytra around the scutellum; a lateral stripe that connects at the humeral angle with the first of four oblique bands on the elytra. The spaces occupied by the darker portions are depressed and less pilose. The elytra are separately narrowed at the apex and armed with a spine. The head is strongly impressed between the eyes. The work of the larvae is well represented on the plate.

Natural enemies. No literature on this subject exists; but we have found a number of affected alders which showed the work of woodpeckers, and evidently these valuable birds are very efficient factors in reducing the numbers of the borers. In one short limb we found four good sized holes made by the birds in their search for grubs [pl. 14]. We have also found many of the larvae destroyed by a dipterous parasite which pupated in the burrows after destroying the maker; several larvae or pupae of this Tachinid are usually found in each working.

Another small dipterous larva is sometimes found in considerable numbers feeding on the larva or pupa but we have not been able to rear it.

Bibliography

1826 **Say, Thomas.** Acad. Nat. Sci. Phila. Jour. 5:274 (Original description); same in Ent. N. Am. Compl. Wr. 1883. 2:332
1852 **LeConte, J. L.** Acad. Nat. Sci. Jour. ser. 2, 2:162 (Description)
1853 **Haldeman, S. S.** Am. Phil. Soc. Jour. n. s. 10:55 (Listed as Anaerea obliqua)
1877 **Provancher,** *L'abbé* **L.** Faune Ent. Can. 1 Coleopt. p.632, 633 (Description, rare at St Hyacinthe)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera, Buffalo and Vicinity, p.10 (Listed)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.623, fig. 204 (In alder)
1890 **Smith, J. B.** Cat. Ins. N. J. p.211 (Rare on black alder)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. 4:80 (In common alder)
1896 **Knab, Fred.** Ent. News, 7:113 (Beetle near tips of branches, Chicopee Mass.)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:146, 148 (Systematic account)
1898 **Wickham, H. F.** Can. Ent. 30:40, 42 (Specific characters, food plant)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.215 (Attacks alder and hazel); same in Ent. State Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Ins. N. J. State Bd Agric. 27th Rep't, sup. p.296 (In black alder)

Saperda mutica Say

Life history. Very little is recorded concerning the life history of this species. Beetles were taken by Mr W. H. Harrington on May 15 and captured by him in the open on June 29. He records this species as living on decaying willow.

Distribution. This beetle has been recorded from the following localities: Missouri [Say], Buffalo [Zesch-Reinecke], New Jersey [Smith], Ottawa Can. [Harrington], Canada, New York, New Jersey, Missouri, Kansas and Nebraska [Leng-Hamilton], Philadelphia Pa. [Wenzel]. Dr LeConte thought that this species was probably the S. populnea of Fabricius and Olivier. Its work is unknown to us.

Description. Black, sparsely covered with a gray or fulvous vestiture which is denser in places, forming numerous spots on the elytra [pl. 7, fig. 2]. These denser places are usually yellower in color. Antennae short, annulate, with first joint enlarged. Thorax narrowed in front with a fulvous line on dorsum, continuing on the head, also lateral line on sides. Head impressed in front between the eyes.

Bibliography

1824 **Say, Thomas.** Acad. Nat. Sci. Phila. Jour. 3:409-10 (Original description; habitat, Missouri); same in Ent. N. Am. Compl. Wr. 1883. 2:191

1852 **Le Conte, J. L.** Acad. Nat. Sci. Phila. Jour. ser. 2, 2:162 (Description, distribution)

1853 **Haldeman, S. S.** Am. Phil. Soc. Trans. n. s. 10:55 (Listed as Anaerea mutica)

1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera, Buffalo and Vicinity, p.10 (Listed)

1884 **Harrington, W. H.** Can. Ent. 16:73, 101 (On willow)

1890 —— Ent. Soc. Ont. 20th Rep't, 1889, p.52 (Mention)

1890 **Smith, J. B.** Cat. Ins. N. J. p.211 (Rare on willow)

1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 148 (Systematic account)

1898 **Wickham, H. F.** Can. Ent. 30:40 (Specific characters)

1899 **Smith, J. B.** Ins. N. J. State Bd Agric. Sup. 27th Rep't, p.296 (On willow)

1902 **Joutel, L. H.** Ent. News, 13:33-34 (Saperda hornii, compared with)

Saperda hornii Joutel

This species [pl. 7, fig. 3] has been mistaken for S. mutica, but can be easily separated from it by the first joint of the antennae being normal in size and also by the fact that the last abdominal segment of the female has a deep longitudinal impression along the middle of the upper side, while mutica has that part convex. The punctures of this insect are also much larger and deeper, and fewer in number.

Some specimens have lost the yellow marks and are entirely gray.

Distribution. Oregon, Los Angeles Cal.,[1] Humboldt county, Cal., Nevada county, Cal., Yosemite Cal., Goldendale Wash.

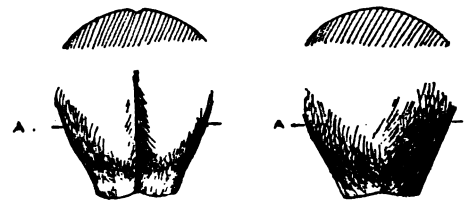


Fig. 4 Last dorsal segment with transverse section at A: 1 S. hornii; 2 S. mutica

Description. Black; shining, entirely covered with a dense layer of light yellowish gray hair, lighter beneath, and diversified above with irregular blotches and streaks of dark yellow arranged on the elytra in broken and irregular longitudinal lines, the line nearest the outer margin and just below the humeral angle unbroken except by the punctures, and continuing nearly to the tip. Elytra obliquely narrowed at apex. Thorax cylindric, sometimes slightly narrowed in front, with a longitudinal stripe of dark yellow hair on each side and on top, under side yellow. Scutellum yellow. Entire insect covered by rather large and deep punctures, slightly smaller beneath. Head: hairs yellow, changing to gray at labrum. Legs and under side of body light yellowish gray with glabrous punctures. Antennae annulate except first joint, which is entirely gray and

[1] In the original description, the locality of the type male in the national museum was wrongly given as Yosemite Cal. It should be Los Angeles Cal.

moderate in thickness. The pygidium of the female has a deep longitudinal depression along the median line, dividing it into two lobes.

Its work is unknown. Mr J. J. Rivers and Dr H. C. Van Dyke have both taken it from willow.

Bibliography

1902 **Joutel, L. H.** Ent. News, 13:33-34 (Original description)

Saperda candida Fabr.

Round-headed appletree borer

There is perhaps no better known enemy of appletrees than the above named insect. The common designation, apple borer, usually refers to this insect, though by common consent it is gradually becoming known as the round-headed appletree borer in contradistinction to the destructive flat-headed species, Chrysobothris femorata Fabr., which is frequently very abundant in appletrees. The round-headed appletree borer is particularly injurious to young trees, and it is probably responsible for the death of more of these than all other natural agents combined.

Early history. This species was very early known as a notorious pest throughout New England and the Middle states according to Dr Harris. Mr Philip Heartt of Troy lost in 1825 several hundred young appletrees which he valued at $2000, many of them being so seriously affected that the base of their trunks was literally honeycombed by the galleries. The late Dr Asa Fitch stated that, of $10,000 worth of trees sold in Washington county in 1851, fully one half were destroyed within eight years. Not infrequently the borers were so abundant as entirely to girdle the tree. Mr William Couper, in 1862, attributed the great destruction of appletrees about Quebec to the ravages of this insect. Mr D. B. Wier, of Wisconsin, writing of this species in 1872, characterizes it as one of the worst enemies of fruit trees and states as his opinion, that it would destroy 5000 out of 10,000 young trees within three years. Dr

J. B. Smith considers this borer very destructive to young apple-trees in many parts of New Jersey and states that it is a more serious enemy of the quince. Miss Mary Treat, of Vineland N. J., writing of this insect in 1893, stated that it was unusually abundant in that section and threatened to kill the trees in spite of all efforts, 10 to 12 borers being found in one. Mr G. T. Powell, of Ghent N. Y., reports taking 30 grubs from a tree in 1889, a year when they were unusually abundant.

The work of this insect is so insidious that it is difficult to gain an adequate idea of its great destructiveness, specially as the sickly condition of the trees is frequently attributed to some other than the true cause.

The above brief records will give some idea of how dangerous an enemy this beetle is; and it is very likely that in future years appletrees will have to be guarded more closely than in the past, if they are to be protected from serious injuries by this pest.

Life history. The adult beetles have been observed abroad during June, July and August. Dr Fitch states that the beetles begin to appear in Washington county, N. Y., about June 20. They are secretive in habit and deposit eggs in the bark near the ground. Mr Zimmerman records the appearance of the beetle June 2 and 3, 1878, and adds that this date is 20 days earlier than usual. Prof. Cyrus Thomas, writing of this pest in 1877, states that it appeared in May in Illinois, and Mr D. B. Wier, of Wisconsin, gives the date of the appearance of the beetles from the middle of May to the middle of June. Mr Tallman has recorded finding this species in copulation on elm June 7. Dr J. B. Smith, state entomologist of New Jersey, gives the date of the occurrence of the beetles from May 20 to July 15.

The egg of this borer is a pale, rust-brown color, about ⅛ inch long, one third as broad in the middle and somewhat flattened, so that its depth is about one third its width. It is rather easy to find eggshells in the oviposition scars [pl. 1, fig. 2], and it will be seen that they are fairly tough, without any sculpture and sufficiently plastic to receive impressions of wood fibers between which they may be placed.

The oviposition scars [pl. 1, fig. 2; pl. 8, fig. 1] may be readily detected as longitudinal slits in the bark, ranging from ¼ to as much as ¾ inch in length. These scars have somewhat irregular, dried edges, and in early spring usually have small, rust-red borings hanging therefrom [pl. 8, fig. 2]. Their location is made more apparent by the adjacent discoloration and shrinking of the areas where the young grubs are at work in the underlying green tissues [pl. 8, fig. 3]. These scars are sometimes very abundant on young trees. The writer observed 11 of them on a portion of a smooth trunk less than 6 inches long and 1½ inches in diameter [pl. 8], and all were within 6 inches of the ground, two being close to its surface. The importance of these marks lies in the fact that they indicate the location of the young grubs, which may be reached and destroyed in the fall or early spring without material injury to the tree. The splitting of the bark is primarily caused by the female in preparing for deposition of her eggs, and the orifice is further enlarged by the consequent shrinkage and drying following the operations of the grub. On cutting into one of these scars [pl. 8, fig. 3] in early spring, young grubs, ranging in size from ⅛ to ¼ inch in length, may be found in the shallow cavity in the inner bark and outer sapwood, and in some cases remains of the eggshell may be observed. The method of oviposition has been described by Dr C. V. Riley as follows:

> The female beetle makes an incision in the bark, causing it to be split from ⅛ to sometimes ½ an inch. The incision is often made entirely through the bark, and the egg is thrust between the bark and the liber at right angles to one side of the slip, from ⅛ to ¼ of an inch from the aperture. Sometimes the bark is but partially penetrated, in which case it is pried open on one side of the aperture for the reception of the egg. In either case the egg is accompanied by a gummy fluid which covers and secures it in place and usually fills up the aperture. In young trees, with tender bark, the egg is usually thoroughly hidden; while in older trees it is sometimes so shallowly embedded as to be readily seen.

Mr W. Junkins, in the *New England Homestead* of Jan. 3, 1885, has also described this interesting process, as it occurs on twigs set in moist sand in a jar: June 15 he observed one of four females

deposit an egg. "She first made an incision in the bark close to the sand; then, turning her head upward, with her ovipositor she placed the egg in the bark nearly ¼ of an inch from the incision, the bark having been started from the wood."

Mr D. B. Wier states that the beetles copulate from 10 days to two weeks after reaching maturity, and soon after the females commence to lay eggs. They are mostly deposited by night, usually from 1 to 10 inches from the ground. He observed that, where the beetles are numerous, several females will often lay their eggs on the same tree at different times, sometimes as long as two or more months apart. He has found as many as 27 young borers of eight different sizes in one tree in September. The eggs are said by Professor Chambers to hatch in about 14 days, and Professor McMillan gives the time as 18 days. The period observed by Mr Junkins, June 15 to July 7, was 22 days. Mr Buckminster believed that the females lay about 10 eggs, which hatch in about eight days, as stated by Gay. Dr Saunders, in his *Insects Injurious to Fruit*, states that the beetle bores into the bark and deposits an egg in the cavity thus made; and Dr Dimmock, writing of this species in the *Standard Natural History*, observes that the cavity is filled with a cementlike secretion.

The young borer, or larva, almost invariably works downward just under the bark, making a somewhat sinuous channel with an oval enlargement at a variable distance from the point where the egg was laid. This oval chamber is evidently where the winter is passed. The presence of the insect is readily detected later, or in spring, by the rust-red borings which are ejected or forced out of the galleries [pl. 1, fig. 3]. There has been some discussion as to whether the larva actually ejects the borings. Dr Fitch was of the opinion that they commonly had the aspect of not having been forced out by the worm but of being thus crowded out because the mass under the bark swelled when dampened by rain soaking through the dead tissues and saturating the contents of the galleries. This explanation did not satisfy us. Our observations have been that the older larvae of this species always have more or less clear gallery space to travel about in and this they keep clear for the time being. They connect the interior workings with the chambers under the bark where they

fed on the sap. When gnawing in the interior galleries they throw the debris behind and void their excrement from time to time while working; when tired or with hunger satisfied they take this frass in their mandibles and pack it in the galleries and corners of the "bark" chamber out of the way occasionally removing and repacking in some other place. They will also carry it to openings in the bark of their feeding chambers, and push it out, using the mandibles only. When at work in the "bark" chamber they void their excrement through one of the openings, ejecting it so that it will fall outside. This is usually done when the voided matter is soft and watery.

The life history of this insect may be summarized as follows: The young borer, on the approach of winter, descends as near the ground as its burrow will allow and remains inactive till the following spring, when it begins operations anew, and on the approach of the second winter it is about half grown and still living in the sapwood. It is at this period that the most damage is done, for, where four or five occur in a single tree, they almost girdle it. The next summer, when it has become about three fourths grown, it cuts a cylindric passage upward into the solid wood and, having finished its larval growth, continues this passage to the bark, sometimes cutting entirely through a tree to the opposite side and sometimes turning back at a different angle. Several borers in one tree will fairly riddle its base [pl. 9]. The upper end of the passage is stuffed with fine borings and the lower part with long wood fibers [pl. 1, fig. 5, 6]. After this the larva remains unchanged through the winter, transforming to a pupa the following spring, and the beetle appears some time during the summer, leaving through a circular exit hole [pl. 1, fig. 7; pl. 9]. The latter frequently becomes overgrown, as represented in plate 8, figure 4.

Habitat. This species is said by Dr LeConte to occur in the Middle, Western and Eastern states. Professor Cook states that it is widely distributed in Michigan, and Rev. C. J. S. Bethune, writing of the insect in 1877, records it as very abundant in the Niagara district and in the vicinity of Montreal and Quebec. Professor McMillan stated in 1888 that every orchard in Nebraska was infested.

It has been recorded specifically by various writers, from Canada, all of New England, Delaware, Maryland, Michigan, New York, New Jersey, Pennsylvania, Ohio, Missouri, Iowa, Kansas, Texas, Alabama, Mississippi, Oklahoma, Virginia, Arkansas, West Virginia, District of Columbia, and Mount Desert Me. [Harris].

Food plants. This pernicious borer is apparently limited to relatively few food plants. It is specially injurious to the quince and nearly as much so to the apple. Its native food plants are the thorn, mountain ash, chokeberry (Pyrus arbutifolia) and shad bush. It has been recorded by Walsh as rare on pear and by Beutenmuller as attacking plum and cherry.

Description. Brown above with two white bands joined at the front and extending to the apex of elytra, under side and front of head white. Antennae light gray, legs lighter gray [pl. 1, fig. 1].

Natural enemies. Not very many enemies of this insect have been discovered. An undetermined carabid larva was found preying on the borers by Walsh and Riley in 1866. Promachus saperdae Riley M. S., now known as Cenocoelius populator Say, was bred from borers received from Indiana by Messrs Riley and Howard in 1890. The downy woodpecker and the great golden woodpecker have been seen in infested orchards by Miss Mary Treat of Vineland N. J. but none of them were observed at work around the base of the trees. Dr Fitch in his first report states that the downy woodpecker, which is frequently seen in the orchards, is one of the means provided by nature for keeping this insect in check, and adds that a neighbor, who had devoted much attention to birds and their habits, informed him that he had repeatedly noticed this woodpecker remaining for a considerable time down at the very root of appletrees, busily occupied in some operation. This would seem to be very good evidence that this bird does prey on this borer. That woodpeckers do this is conclusively proved by specimens recently collected in the vicinity of Albany, which show the characteristic work of these birds, but unfortunately give no clue to the identity of the operator.

Preventive and remedial measures. The control of an insect pest of this character may be brought about in two ways: (1) the

insect may be prevented from infesting the tree in some manner, or (2) destroyed after it has obtained entrance.

Dr Fitch had his attention called to the beneficial effect of soap applications, and he states that, if the bark of the trees be rubbed with soap the latter part of May, no borers will attack them. This was tested by him with the result that treated trees were free from the pest, while almost all of the untreated ones were infested with borers. One of the latter, only 3½ inches in diameter, contained 15 of the grubs. Mr Fowler has proposed the use of 2 quarts of whale oil soap and ¼ pound of sulfur and enough clay to give the mixture the consistency of paint, and advises applying the compound early enough to prevent the deposition of eggs. Professor Cook in 1881 thought washing the trunks and larger branches of the trees in May and the last week in June with soap would protect them from the borers, and Prof. C. M. Weed has advised the use of what we know as the carbolic soap wash and observes that it is very effective when thoroughly applied. Some observers, however, state that soap applications, and similar preventive measures, are of comparatively little value, and a few consider the alkaline washes more effective than soap. A band of tarred paper, or bands of newspaper, wrapped tightly around the base of young trees during the period the beetles are abroad, affords considerable protection and is used rather extensively in some fruit-growing sections. The bands should extend from the soil about 2 feet high, should be tied at the top so that the beetles can not get behind the band and should make a fairly tight connection with the ground. Professor Slingerland has recently advised trying a coating of coal tar, first testing to see if the trees were injured by this substance. Whitewashing the trunk has also been advised by certain writers and appears to have a somewhat deterrent effect. The application is comparatively inexpensive and, in absence of anything else, may well be employed. Dr J. B. Smith has advised the use of a poisoned whitewash. The use of ashes about the roots is also good, since, if they are heaped somewhat, they will protect the lower portions

of the tree from injury. The idea of these applications is to coat the bark or protect the base of the tree with some substance which will deter the beetles from depositing their eggs and therefore prevent infestation. These applications should be made in this latitude by the latter part of May and again early in June, or, in the case of permanent bands, the application of them at the earlier date is sufficient. Dr Fitch states that, in his observation, the worst infested trees are shaded and choked by suckers, and he therefore urges keeping the base of the trees clean. It is undoubtedly a good practice to observe this advice, since it at least permits the ready detection of the borers. We believe that suckers at the base of the tree are frequently caused by serious injuries by the larvae, and our experience indicates that a tree with an unprotected trunk is almost as likely to be attacked by the insect as one with its base shaded.

Thomas Say in 1825 recommended covering infested trees the latter part of April or early in May with mortar in order to prevent the emergence of the borers. This, so far as we can learn, has never been extensively tried and is of doubtful value. After the insect has once made its way into the tree, there is nothing better than cutting out the borers and destroying them, or killing them with a wire while in the tree. Either operation is best carried out in September or October or in early spring, because the work of the young borers is apparent at this time, and the recent borings facilitate their detection. A young tree will recover if the bark be extensively cut with a knife, and the overcautious operator should remember that the borer is very likely to cause more injury if allowed to remain. The use of the wire will undoubtedly avoid considerable cutting in some instances, and it should be employed wherever practicable. Dr Fitch has advised cutting into the upper part of the boring, removing the sawdust and then killing the pest by pouring in a considerable quantity of hot water. This is undoubtedly efficient; but it appears to have a limited application, and in most cases it is probable that cutting out or destroying with a wire is to be preferred.

The quince suffers most from this borer, and perhaps the best method of controlling the pest in quincetrees is that described

by Mr Woodbridge Strong in the issue of the *Country Gentleman* for Mar. 20, 1890. His plan consists in providing the quince with a trunk which is practically borer-proof, and he accomplishes this by first taking stocks of English hawthorn and grafting on them varieties of Crataegus crus-galli or coccinia, which are worked on the hawthorn at the surface of the ground, and a year later hawthorn is worked back onto the native stock about a foot above and then quince on that a few inches higher. This compound tree is then set so that the hawthorn stock is below the surface of the ground and the Crataegus occupies the first foot. Mr Strong states that such trees make very satisfactory growth and fruit readily, and that, while the work of preparing them is difficult and involves considerable labor, the results amply justify the expense.

Bibliography

1787 **Fabricius, J. C.** Mantissa Ins. 1:147 (Description)
1792 ——— Ent. Syst. 2:307 (Description)
1801 ——— Syst. Eleu. 2:319 (Description)
1824 **Say, Thomas.** Acad. Nat. Sci. Phila. Jour. 3:409 (Described as S. bivittata); same in Compl. Wr. 1883. 2:190-91
1826 **Buel, Jesse.** Mass. Agric. Repos. and Jour. July, v.9, no. 2, p.191-95 (Describes ravages of S. bivittata; Philip Heartt's letter)
1826 **Harris, T. W.** N. Eng. Farmer, Dec. 22, 5:171 (Mention, as S. bifasciata)
1826 **Heartt, Philip.** Bd Agric. State N. Y. Mem. 3:478 (Several hundred young trees killed at Troy, loss $2000; as S. bivittata)
1826 **Say, Thomas.** Bd Agric. State N. Y. Mem. 3:479-80 (Identity, habits, description)
1831 **Prouty, Daniel.** Mass. Agric. Repos. and Jour. January, 10:273-74 (Banking with sharp gravel advised)
1842 **Harris, T. W.** Mass. Ploughman, Jan. 22, v.1, no. 17, p.1, figure ; reprint in N. Eng. Farmer, Feb. 16, 20:260-61 (Life history, description and figures; as S. bivittata)
1843[1] **Buckminster,** Mass. Ploughman, Nov. 11 (Observations on apple-tree borers)
1844 **Gaylord, W.** N. Y. State Agric. Soc. Trans. 1843, 3:157-58, fig. (Brief general notice in N. Eng. Farmer. 1845. 23:314, 315)
1844 **Harris, T. W.** Farmers Cab. and Am. Herdbook, 8:214 (Compared with S. vestita as S. bivittata)
1845 **Fitch, Asa.** Insects injurious to Vegetation, no. 1, Am. Quar. Jour. Agric. and Sci. 1:251-52 (Injuries in Troy, habits, remedies, as S. bivittata)

[1]Reference unverified.

1846 **Morris, M. H.** Insects, no. 2, Am. Agric. 5:98, fig.29 (Brief general notice)

1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. 2:163 (Description, habitat, very injurious to appletrees)

1852 ——— Acad. Nat. Sci. Phila. Jour. ser. 2, 2:163 (Description, distribution)

1853 **Haldeman, S. S.** Am. Phil. Soc. Trans. n. s. 10:55 (Synonymy, distribution)

1854 **Emmons, E.** Nat. Hist. N. Y. Agric. 5:119-20, pl.16, fig.3 (Injuries at Troy, habits and remedies)

1855 **Fitch, Asa.** N. Y. State Agric. Soc. Trans. 1854, 14:715-29 (Detailed account as S. bivittata); same in Noxious and Other Ins. N. Y. 1st and 2d Rep'ts. 1856. p.11-25.

1856 ——— Noxious and Other Ins. N. Y. 3d Rep't, p.3-7 (Notes on life history, injuries, remedies); same in N. Y. Agric. Soc. Trans. 16:321-25

1857 **Fowler, Sam P.,** *sec.* Mass. Bd Agric. 4th Rep't, p.448 (Brief general account)

1858 **Briggs, Nathan.** Country Gentleman, July 8, 12:14 (Value of oil and soap for borers)

1858 **Fitch, Asa.** Country Gentleman, July 8, 12:15 (Experiments with soap against S. bivittata)

1858 ——— Cultivator, ser. 3, August, 6:238 (Efficacy of soap against S. bivittata)

1859 ——— N. Y. State Agric. Soc. Trans. 19:594-95 (Injuries in Washington county, soap as a remedy)

1859-60 **Walsh, B. D.** Ill. State Agric. Soc. Trans. 4:345 (Rare in Illinois. Fitch experiments with soap)

1860 **Rathvon, S. S.** Entomological essay read before the Fruit Growers Ass'n Eastern Pa. Gardeners Mo. October, 2:300 (Mention); December, p. 356, pl. 1. (Brief general notice as S. bivittata)

1861 **Uhler, P. R.** Com. Patents Rep't 1860. Agric. p.317-18 (Brief general account)

1861 **Walsh, B. D.** Ill. State Agric. Soc. Trans. 1859-60, 4:345 (Brief comparison with Chrysobothris femorata); reprint in part in Ill. Nat. Hist. Soc. Bul. Trans. 1861, p.159; Prairie Farmer, Dec. 6 [v. ?] n.s.v. ?, p.370-71 (Notes on S. bivittata)

1862 **Couper, William.** Can. Nat. and Geol. 7:278-81, 3 figures (Habits and ravages around Quebec)

1862 **Harris, T. W.** Insects Injurious to Vegetation, p.107-9 (Injurious, habits, remedies, as S. bivittata)

1862 **Packard, A. S.** Nat. Hist. Soc. Me. 2d Rep't, in Agric. Me. 7th Rep't, p.192 (Figure and mention)

1862 **Rathvon, S. S.** Com. Patents Rep't 1861. Agric. p.617-18, fig.77, 78, 83 (Brief general account)

1865 **Riley, C. V.** Prairie Farmer, Jan. 14, [v.31] n.s. 15:21, 5 figures (Figure of imago of S. bivittata)

1865 **Walsh, B. D.** Ill. State Agric. Soc. Trans. 1861-64, 5:499-501 (Habits and remedies)

1866[1] **Brackett, G. E.** Prac. Ent. no.2. Me. Farmer, May 10, S. b. no. 1, p.102 (Describes larva, habits, and means against S. bivittata)
1866[1] ——— Prac. Ent. no. 5. Me. Farmer, June 7, S. b. no. 1, p.103, (Notes on S. bivittata)
1866[1] ——— Prac. Ent. no 9. Me. Farmer, July 12, S. b. no. 2, p.18, 19; Bib. Eco. Ent. pt3, no. 914 (Means against S. bivittata)
1866[1] ——— Prac. Ent. no. 16. Me. Farmer, Aug. 30, S. b. no. 2, p.22, 23 (Seasons of S. bivittata)
1866[1] ——— Prac. Ent. no. 17. Me. Farmer, Sep. 6, S. b. no. 2, p.23, 24 (Picus pubescens destroys larva of S. bivittata)
1866[1] ——— Prac. Ent. no. 18. Me. Farmer, Sep. 13, S. b. no. 2, p.24 (Plugging as a means against S. bivittata)
1866 **Walsh, B. D.** Borers. Prac. Ent. 1:26, fig. 1 (Natural history and means against, as S. bivittata)
1866 ——— Prac. Ent. Mar. 26, 1:47 (Larval habits after Fitch, as S. bivittata)
1867[1] **Riley, C. V.** Prairie Farmer, Jan. 12, n. s. 19:23 (Remedies etc.)
1867 ——— Prairie Farmer, Feb. 2, 19:69 (Mention)
1867 ——— Prairie Farmer, June 8, 19:381 (Brief notice)
1867 **Walsh, B. D.** Prac. Ent. 2:92-93 (Food plants as S. bivittata)
1867[1] ——— Northern Ill. Hort. Soc. Trans. 1867-68, p.91-96 (Six worst enemies of fruit growers, S. bivittata)
1868[1] **Beadle.** Fruit Growers Rep't, p.172 (Prize essay on S. bivittata)
1868[1] **Riley, C. V.** Prairie Farmer. July 11 [v.38] n.s. 22:10, S. b. no. 3, p.32, 56 (Answer to W. Colwell: ravages of S. bivittata)
1868[1] ——— Coleman's Rural World, S. b. no. 3, p.16 (Means against S. bivittata)
1868 ——— Ill. State Hort. Soc. Trans. 1867, 1:108-9 (Saperda less numerous than Chrysobothris)
1868 ——— Noxious and Beneficial Ins. Mo. 1st Rep't, p.42-46, fig. 14 (Detailed account as S. bivittata)
1868 **Walsh, B. D. & Riley, C. V.** Am. Ent. October, 1:39 (Undetermined carabid larva probably preying on larva)
1869 **Packard, A. S.** Guide to the Study of Insects, p.500-1 (Brief general notice)
1869 **Walsh, B. D. & Riley, C. V.** Am. Ent. 1:168 (Advises digging out, as S. bivittata), p.245 (Identified)
1870[1] **Bethune, C. J. S.** Agric. and Arts Ass'n Ont. Trans. 25th Year, p.375-77 (Brief general account)
1870 **Riley, C. V.** Am. Ent. and Bot. 2:276 (Variations in color), p.306 (Larvae can not live in dead trees, as S. bivittata)
1870 ——— Noxious, Beneficial and Other Ins. Mo. 2d Rep't, p.19 (Life cycle 3 years, as S. bivittata)
1870 **Wielandy, J. F.** Am. Ent. 2:148 (Habits, ravages, and remedies, as S. bivittata)
1871 **Bethune, C. J. S.** Ent. Soc. Ont. 1st Rep't, p.69-71, fig. 2 (General account, quotes Beadle as S. bivittata)

[1]Reference unverified.

1871 ——— Fruit Growers Ass'n Ont. Rep't, 1870, p.69-71 (Characters, habits and means against S. candida)

1872 **Dimmock, G.** N. Eng. Homestead, June 22, v.5, no.7, p.49 (Treats of S. candida)

1872 **Wier, D. B.** Wis. State Hort. Soc. Trans. p.156-63, fig. 14 (Detailed account; deals with S. candida as a most noxious insect to fruit growers)

1872-73 **Smith, S. I.,** *sec.* Ct. Bd Agric. 6th Rep't, p.348-49, fig. 3 (Brief notice)

1873 **Bessey, C. E.** Ia. State Agric. Soc. Rep't, p.238-39, fig. 5 (Brief notice)

1873 **LeConte, J. L.** New Sp. N. Am. Coleopt. pt2, Smithsonian Miscel. Coll. 264, p.238-39 (Specific characters)

1873[1] **Riley, C. V.** N. Y. Tribune, May 23, S. b. no. 8, p.64 (Answer to J. Durbin; means against S. bivittata)

1874 **Cook, A. J.** Mich. State Bd Agric. 13th Rep't, p.124-25, fig. 2 (Widely distributed in the state, habits, remedies)

1874 **LeBaron, William.** Noxious and Beneficial Ins. Ill. 4th Rep't, p.157, 159, fig.77 (Mention, as S. bivittata)

1874[1] **Riley, C. V.** N. Y. Tribune, Ap. 8, S. b. no.10, p.34 (Answer to T. H. Wakeley: means against S. bivittata and Chrysobothris femorata, apply soap)

1874[1] **Tracy, William W. & Parmelee, George.** Injurious Insects. Rep't read before the Peninsula Farmers Club at Old Mission Mich. Traverse City. p.12 (S. candida, means against)

1875[1] **Bartlett, J. N.** N. Eng. Farmer, rec. nos. 16-18, v.53 (n. s. v.29), nos. 24-39; Psyche, Sep. 1875, p.103 (S. candida, means against)

1875[1] ——— N. Eng. Farmer, v.54 (n. s. v.30) no. 28; Psyche, Sep. 1875, p.104 (S. candida)

1875[1] **Bell, J. T.** Fruit Growers Rep't. (Notes S. candida captured near Belleville, no doubt imported)

1875 **Cook, A. J.** Cultivator and Country Gentleman, 40:455 (Brief general notice)

1875 ——— Mich. State Bd Agric. 13th Rep't, 1874, p.124-25, fig. 20 (Brief general notice)

1875 **Fernald, C. H.** Me. State Pomo. Soc. Trans. 1874, p.97-98 (Brief general account)

1875[1] **Riley, C. V.** Coleman's Rural World, Nov. 13, S. b. no. 10, p.188 (Timber trees near apple orchards increase the likelihood of attack by S. bivittata)

1876 **Bell, J. T.** Fruit Growers Ass'n Ont. Rep't, 1875, p.35-36 (Brief description with remedies)

1876 **Hoffmeister, A. W.** Ia. State Hort. Soc. An. Rep't, 1875, p.204-5 (Remedies, ravages and means against S. bivittata)

1876 **Perkins, G. H.** Vt. Bd Agric. 3d Bien. Rep't, p.599 (Brief general notice)

[1]Reference unverified.

1876[1] **Riley, C. V.** Coleman's Rural World, Aug. 9, S. b. no. 14, p.3-4, 55-56; extract in Cultivator and Country Gentleman Sep. 7, 1876, 41:566 (Answer to F. H. Chrysobothris femorata distinguished from S. bivittata [=candida])

1877 **Bethune, C. J. S.** Can. Ent. December, 9:224, pl. , fig. 6 (Injuries, beetles and larva described, abundant in Niagara district and about Montreal and Quebec)

1877 ——— Ent. Soc. Ont. Rep't for 1877, p.26-28, pl. , fig. 3, 6 (Same as above but with life history and remedial measures additional)

1877 **Fuller, A. S.** Moore's Rural New Yorker, May 19, 19:247 (Synonymy, brief account)

1877 **Provancher, *L'abbé* L.** Faune Ent. Can. 1 Coleopt. p.632, 633-34, fig. 48 (Description)

1877[1] **Riley, C. V.** N. Y. Tribune, Dec. 26, S. b. no. 14, p.234 (Ravages and means against S. bivittata)

1877 **Thomas, Cyrus.** Noxious and Beneficial Ins. Ill. 6th Rep't, p.35, 38, 44, 83, 84 (References), p.152-56 (Description, detailed life history, remedial measures, as S. bivittata)

1878 **Riley, C. V.** Acad. Sci. St Louis. Trans. Dec. 1877, Jour. Proc. cclxix-cclxx (Describes egg and manner of oviposition of S. bivittata [=candida])

1878[1] ——— N. Y. Wk. Tribune, Feb. 20, S. b. no. 19, p.193-94; reprint in Coleman's Rural World, Mar. 20, 1878, S. b. no. 14, p.267-68, with slight omission in the same, Mar. 12, 1879, S. b. no. 23, p.101-2; Mirror and Farmer, Ap. 6, 1878, S. b. no. 20, p.3 (New facts, describes egg, oviposition, seasons of oviposition, means against S. bivittata)

1878 **Zimmerman, C. D.** Can. Ent. 10:220 (Adults appeared June 2, 3—20 days earlier than usual)

1878-79 **Hoy, P. R.** Wis. State Hort. Soc. Trans. 9:233 (Rare as S. bivittata)

1878-79[1] **Osborn, Herbert.** Ia. State Hort. Soc. Trans. 13:368-402, 19 figures (Habits and natural history of S. bivittata)

1879 **Brackett, G. E.** Kan. State Hort. Soc. Rep't, 9:186-90, 198-200 (Description, life history and remedies with note replying to Riley)

1879 **Osborn, Herbert.** Coll. Quar. May, 2:8; Western Stock Jour. and Farmer, July 1879, 9:142 (Natural history of S. bivittata)

1879 ——— Ia. State Hort. Soc. Trans. 1878, 13:392-93 (Life history, remedies, figures, as S. bivittata)

1879 **Riley, C. V.** Kan. State Hort. Soc. Rep't, 9:196-98 (Habits and remedies)

1879 **Stout, O. E.** Kan. State Hort. Soc. Rep't, 9:87 (Brief notice)

1880[1] **Bateman, ——.** Country Gentleman, 45:246 (Wash for borers)

1880 **Clay, C. M.** Land and Home, Jan. 1, 1:139 (Sap-suckers destroy borers)

1880[1] **Osborn, Herbert.** Western Stock Jour. and Farmer, July 10, p.153 (Answer to inquiry: habits of S. bivittata)

1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)

[1] Reference unverified.

1881 **Cook, A. J.** Can. Ent. 13:191 (Soft soap protects trees)
1881 **Osborn, Herbert.** Ia. State Hort. Soc. Trans. 1880, 15:111, 112 (S. cretata compared with)
1882 **Lintner, J. A.** Injurious and Other Ins. N. Y. 1st Rep't, p.58, 64 (Remedial measures), p.331 (Listed)
1883 **Atkins, C. G.** Rural New Yorker, 42:688 (Brief note, very abundant in Maine)
1883 **Cooke, Matthew.** Injurious Insects of the Orchard, Vineyard etc., p.65-67, fig.25 (Brief general account)
1883 **Harrington, W. H.** Ent. Soc. Ont. 14th Rep't, p.45, fig. 16 (Mention)
1883[1] **Riley, C. V.** Stoddarts' Encyclopedia Americana, 1:135-42, fig. 1-29 (Round-headed appletree borer, S. bivittata), p.137, fig. 7
1883[1] ——— Rural New Yorker, Oct. 20, 42:693; reprint in Am. Pomo. Soc. 19th Sess. Proc. 1884, p.45; Wis. State Hort. Soc. Trans. 1886, 17:2 (Corrects statements in regard to oviposition of S. bivittata [=candida])
1883 **Saunders, William.** Can. Ent. 15:203 (Oviposits in bored cavity)
1883-89 ——— Insects Injurious to Fruits, p.16-19, 160, 425 (Brief general account)
1883 ——— Ent. Soc. Ont. 14th Rep't, p.16 (Oviposits in bored cavity)
1884 **Atkins, C. G.** Rural New Yorker, Jan. 12, 43:19 (Notes on oviposition, as S. bivittata)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:325 (Brief general notice, as S. bivittata)
1884 **Riley, C. V.** Insects in Relation to Agriculture, Encyclopedia Americana, 1:137 (Brief general account, figures)
1884 ——— Rural New Yorker, Mar. 1, 43:132, fig. 73 (Notice of paper of C. G. Atkins: confirms method of oviposition of S. candida, describes method; corrects statements by William Saunders, describes and figures egg of S. candida, figures, burrows and exit holes; figures, pupa and position of egg when deposited)
1884 ——— Am. Pomo. Soc. 19th Sess. Proc. 1883, p.46 (Reference to oviposition)
1885[1] **Atkins, C. G.** Home Farm. Mar. 5, 1885 (Notes on oviposition of S. candida)
1885[1] **Junkins, E. W.** N. Eng. Homestead. Jan. 3, 1885 (Notes on oviposition of S. candida)
1885 **Lintner, J. A.** Injurious and Other Ins. N. Y. 2d Rep't, p.27 (Mention)
1885 ——— Country Gentleman, July 16, 1:590-91 (Remedial measures discussed in detail)
1886 ——— State Ent. Rep't N. Y. State Mus. Nat. Hist. 39th Rep't, 1885, p.105-6 (Oviposition and remedies)
1887 **Bethune, C. J. S.** Ent. Soc. Ont. 17th Rep't, p.57-58, fig. 31 (Remedial measures)
1887 **Harrington, W. H.** Ent. Soc. Ont. 17th Rep't, p.30 (Mention)
1887 **Lintner, J. A.** Injurious and Other Ins. N. Y. 3d Rep't, p.105 (Mention)

[1]Reference unverified.

1887 **Stickney, J. S.** Wis. State Hort. Soc. Trans. 1886-87, 17:236-37 (Brief notice, advises shading south and southwest sides of trees)
1888 **Cook, A. J.** Mich. State Bd Agric. 27th Rep't, p.168 (Mention)
1888 **Harvey, F. L.** Me. Agric. Exp. Sta. An. Rep't, p.153-55, fig. 1 (Brief general account)
1888 **Lintner, J. A.** Injurious and Other Ins. N. Y. 4th Rep't, p.107 (Carbolic acid wash)
1888 **McMillan, Conway.** Agric. Exp. Sta. Neb. Bul. 2, 1:84-85 (Very injurious in Nebraska; natural history and remedies)
1888 **Weed, C. M.** Rural New Yorker, 47:333 (Carbolic soap wash and destroying eggs and young borers very successful)
1889 **Gillette, C. P.** Ia. Exp. Sta. Bul. 5, p.178, fig. 14 (Brief general notice)
1889 **Lintner, J. A.** Injurious and Other Ins. N. Y. 5th Rep't, p.269-71 (Method and duration of egg-laying), p.325 (Reference)
1889 **Tolman, Adams.** Insect Life, 1:343 (On elm)
1889 **Townsend, [C. H.] Tyler.** Psyche, 5:233 (Listed from lower Michigan peninsula)
1890 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, 1889, p.52, fig. 35 (Mention)
1890 **Riley, C. V. & Howard, L. O.** Insect Life, 3:59 (Promachus saperdae [Cenocoelius populator Say] bred from)
1890 **Smith, J. B.** Cat. Ins. N. J. p.211 (On apple, pear and quince)
1890 **Strong, Woodbridge.** Country Gentleman, 65:228 (Preventives, grafting quince on borer-proof thorn, wrapping base of trunk with paper)
1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:31 (Bibliography of transformations)
1891 **Lintner, J. A.** Injurious and Other Ins. N. Y. 7th Rep't, p.313-14, fig. 31 (Newspaper wrapping and resistant stock)
1891 **McCarthy, G.** N. C. Agric. Exp. Sta. Bul. 78, p.27-28 (Brief mention)
1891 **Smith, J. B.** Ent. Soc. Ont. 22d Rep't, p.65 (Any part of trunk and branches of apple and pear may be attacked)
1891 ——— N. J. Agric. Exp. Sta. 11th Rep't, 1890, p.513-14, fig. 26 (Very injurious to young appletrees, more so to quince, remedies)
1891 ——— *& others.* Insect life, 3:249 (Not confined to quince. S. candida not confined to the trunk)
1891 **Weed, C. M.** Insects and Insecticides, p.29-31, fig. 9 (Brief general account)
1891 ——— Columbus Hort. Soc. An. Rep't, 1890, p.29-30 (Brief account, as S. candida)
1892 **Smith, J. B.** Insect Life, 4:43 (Parts of trees attacked)
1893 **Chambliss, C. E.** Tenn. Agric. Exp. Sta. Bul. 1, 6:6-8, fig. 2 (Brief general account)
1893 **Lintner, J. A.** Country Gentleman, 58:387 (Remedial measures)
1893 **Osborn, Herbert.** Ia. State Hort. Soc. Rep't, 17:115-16, fig. 25 (Brief notice)
1893 **Riley, C. V.** Md. Agric. Exp. Sta. Bul. 23, p.86-87, fig. 17, 18 (Brief general account)

1893 **Treat, M.** N. Y. Ent. Soc. Jour. 1:16-17 (Unusually injurious, parts of tree attacked and natural enemies)
1894 **Bruner, L.** Neb. State Hort. Soc. Rep't, p.161, 181-82, fig. 24, 25 (Listed, figured)
1894 **Davis, G. C.** Mich. State Hort. Soc. 24th Rep't, p.77-78, figure (Brief notice)
1894 **Jack, J. G.** Mass. Hort. Soc. Trans. p.137 (Food plants, habits and remedies)
1895 **Comstock, J. H.** Manual for the Study of Insects, p.572-73, fig. 690, 697 (Brief notice)
1895 **Hamilton, John.** Cat. Coleopt. Southwestern Pa., etc. Am. Ent. Soc. Trans. 22:369 (Not rare)
1895 **Lintner, J. A.** Ins. N. Y. 10th Rep't, p.488, 511 (Reference)
1895[1] **Weed, H. E.** Southern Cultivator, Jan. 1895 (Round-headed apple-tree borer, S. candida)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (Attacks apple, pear, plum, quince, cherry, thorn, mountain ash and June berry, Amelanchier)
1896 **Fletcher, James.** Farmer's Advocate, London Ont. Nov. 16, p.480, figure (S. candida in appletrees)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 148-49 (Systematic account)
1896 **Lintner, J. A.** Country Gentleman, 61:949 (Remedial measures in detail)
1896 ——— State Ent. 11th Rep't, p.269 (On apple)
1896 **Smith, J. B.** Eco. Ent. p.209-10 (Remedial measures)
1897 **Bogue, E. E.** Okl. Agric. Exp. Sta. Bul. 26, p.12-14, fig. 8, 9 (Brief general account)
1897 **Fyles, Thomas W.** Ent. Soc. Ont. 27th Rep't, 1896, p.39-40 (Native food plants, thorn, moosemissa, shad bush)
1897 **Johnson, W. G.** Am. Gardening, 18:375 (Brief general notice)
1897 **Lintner, J. A.** Country Gentleman, 62:390 (Soap wash, cutting out)
1897 ——— Injurious and Other Ins. N. Y. 12th Rep't, p.239, 246, 356 (Reference)
1897 ——— Injurious and Other Ins. N. Y. 13th Rep't, p.365 (Reference)
1898 **Bruner, L.** Neb. State Hort. Soc. An. Rep't, p.121-212, 108 figures (Insect enemies of the apple and its fruit under S. candida)
1898 **Chittenden, F. H.** U. S. Dep't Agric. Div. Ent. Circ. 32, p.1-8, fig. 1 (Summary account)
1898 **Faville, E. E. & Parrott, P. J.** Kan. Agric. Exp. Sta. Bul. 77, March, p.50-52, fig. 23-25 (Brief general account)
1898 **Johnston, James.** Can. Ent. 30:71 (Taken June 4 on thorn at Hamilton)
1898 **Stedman, J. M.** Mo. Agric. Exp. Sta. Bul. 44, fig. 6, p.14-16, 18 (Brief general account, results with washes)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Specific characters, food plants)

[1]Reference unverified.

1899 **Beach, S. A., Lowe, V. H. & Stewart, F. C.** N. Y. State Exp. Sta. Bul. 170, p.389 (Brief notice)
1899 **Bruner, Lawrence.** Neb. State Hort. Soc. Rep't, 30:160-61 (Brief mention, figure)
1899 **Felt, E. P.** Country Gentleman, 64:917 (Protective bands and washes advised)
1899 **Fernald, H. T.** Pa. Dep't Agric. Bul. 47, p.12-14, fig. 14 (Brief general account)
1899 **Fyles, T. W.** Ent. Soc. Ont. 29th Rep't, 1898, p.47, fig. 16 (Brief mention)
1899 **Harvey, F. L. & Munson, W. M.** Me. Agric. Exp. Sta. Bul. 56, p.108-9, pl. 2, fig. 1 (Brief general account)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.210-15, fig. 133-34 (Brief general account); same in Ent. State Exp. Sta. 5th Rep't, p.126-31
1899 **Smith, J. B.** Ins. N. J. State Bd Agric. Rep't Sup. p.296, fig. 131 (Brief mention)
1900 **Felt, E. P.** State Ent. 15th Rep't. N. Y. State Mus. Bul. 31, p.554 (Unusually abundant), p.557 (Adults taken on mountain ash July 4), p.574 (Attracted to light), p.577-78 (Mention)
1901 **Webster, F. M.** Ent. Soc. Ont. 31st Rep't, p.83, fig. 44 (Adults gnaw young apples)
1901 **Felt, E. P.** Country Gentleman, Oct. 3, 66:803 (Remedial measures)
1902 ——— Country Gentleman Ap. 3, 67:291 (Injuries to young trees); State Ent. 17th Rep't. N. Y. State Mus. Bul. 53, p.734-35, 834 (Injuries and brief bibliography)
1902 **Patton, J. H.** Am. Agric. 69:357 (Cover infested spots with clay)
1902 **Slingerland, M. V.** Rural New Yorker, Oct. 11, 61:688 (Remedial measures)

Saperda calcarata Say

Poplar borer

This is the largest of our native species and is equaled in size only by the European S. carcharias. This species is of considerable economic importance on account of its serious injury to the trunks and larger branches of poplars. These trees rarely attain any size in New York State before showing the operations of this insect, and in not a few instances very serious injury is inflicted. This applies not only to neglected trees along road sides and in forests but also to magnificent specimens grown for ornamental purposes in parks. In Washington park, Albany, this species has recently caused a great deal of damage, breeding in large numbers in a group of magnificent white poplars. We have also observed similar injury in New York city and Brooklyn.

Early history. Dr Harris, in his classic report, *Insects Injurious to Vegetation*, states that this species in conjunction with the broad-necked Prionus, Prionus laticollis, nearly destroyed the lombardy poplars in the vicinity of Cambridge Mass. in the early 40's. In 1880 Mr Shelby Reed, of Scottsville N. Y., lost two fine trees on a lawn through the depredations of this pest. Dr Packard reports it as very injurious to poplars along the shores of Casco bay, Me., in 1884, and in 1892 it had caused great depredations among the silver poplars of Cincinnati O. according to Charles Dury. Professor Riley, in his early writings, states that this insect has been universally destructive to cottonwoods and poplars in the western states, and Professor Bruner, in his paper, "The Insect Enemies of Ornamental and Shade Trees," states that this borer is by far the most destructive enemy of poplars and cottonwoods in the west. He further adds that it is almost impossible to grow these trees of any size in cities and towns of Nebraska away from the friendly care of birds and parasitic insects.

Life history. The recorded life history of this insect is very meager indeed. Dr Harris states that the beetles [pl. 2, fig. 1] occur on the trunks and branches of various forms of poplar in August and September, and other writers notice the life history of the insect in a very brief manner.

The most obvious signs of infestation are the numerous blackened, swollen scars along the surface of the trunk and limbs. Sometimes these are open, and in early summer large quantities of borings are expelled from the inhabited galleries, and frequently occur in considerable piles about the base of the trees. This is very evident during the latter part of May and in early June. Our observations show that pupae [pl. 2, fig. 2] may be found in considerable numbers in early June in the vicinity of Albany, and that adults appear in early July and continue to emerge throughout that month and probably also during August and into September. In early June we have found full grown larvae [pl. 2, fig. 3] which apparently were nearly ready to pupate, and many pupae, though no beetles breed therefrom

till into July. This would therefore prove that the pupal stage lasts three or four weeks as a general rule. The pupal chamber [pl. 2, fig. 2] is invariably near the center of the smaller limbs and at some distance from the surface in trunks. The top is smoothly cut, and the other end is closely packed with coarse fibers which are attached to the side of the gallery at one end, and the portion next the pupa is packed with much finer borings and then coated with very fine sawdust. This pupal chamber appears to be made the previous season, but transformation to the pupa does not occur, as in other species, till spring. There are no records regarding oviposition habits, but this species, like S. candida, makes a small slit in the bark and deposits its eggs just underneath the surface. The young larva [pl. 10] works in the inner bark and the outer sapwood for a short time and before the approach of cold weather sinks its burrow to a greater depth. The borings of the second year are confined very largely to the interior of the wood, and during this stage the limb or trunk may be honeycombed by very large, somewhat irregular galleries. In the latter stages of their existence, the larvae not infrequently excavate broad shallow galleries in the sapwood and inner bark and appear to subsist to a considerable extent on the sap collected in such cavities. This insect probably requires three years to complete its transformations.

Food plants. This borer has been recorded as destructive to lombardy poplar [Emmons], cottonwood [Walsh], Populus tremuloides, the common aspen [Jack], cottonwood, poplars and willows [Lugger], is not rare on diseased Populus [Hamilton], on cottonwood and other poplars [Adams], very common [Provancher].

Description. Covered with gray hairs, diversified with patches of yellow hairs on the elytra, which latter end in a sutural spine. Thorax with a yellow stripe on top and sides, extending on the head, which is yellow in front; scutellum yellow; underside gray with yellow; legs gray; antennae gray. Sometimes the insect is entirely yellowish brown (var. adspersa).

Distribution. This species has been recorded by Leng and Hamilton, from the following localities: Canada, Wisconsin,

Lake Superior, Michigan, Ohio, Pennsylvania, New York, Massachusetts, New Jersey, Missouri, Kansas, Nebraska, Iowa, Vancouver island, British Columbia, and from Yakima Wash. by Professor Piper. We have seen specimens from Texas, South Carolina, Illinois, Black hills, and Bismarck N. D. It has been found by us at Fort Lee N. J., in New York city and also Brooklyn and Glendale.

Saperda adspersa Lec., a uniformly brown form described from Michigan, is a variety of this species. This variety has also been found at Albany [Joutel] and at Brandt lake in the Adirondacks [J. Doll].

Remedies. It is manifestly impossible to attempt to control this insect on other than valuable trees, and in such situations, digging out the borers, with possibly recourse to the use of repellent washes described on page 29, is about all that can be done and in the majority of instances should afford considerable protection.

Bibliography

1824 **Say, Thomas.** Acad. Nat. Sci. Phila. Jour. 3:408 (Original description); same in Ent. N. Am. Compl. Wr. 1883, 2:190

1845 **Fitch, Asa.** Am. Quar. Agric. and Sci. Jour. p.252, pl. 3, fig. 8 (Description, habits, infests native and lombardy poplars)

1850 **LeConte, J. L.** Lake Superior, Agassiz and Cabot, p.234 (Described as S. adspersa)

1852 ——— Acad. Nat. Sci. Jour. 2:162 (Description, distribution, S. adspersa described)

1853 **Haldeman, S. S.** Am. Phil. Soc. Trans. n. s. 10:55 (Listed as Anaerea calcarata)

1854 **Emmons, Ebenezer.** Nat. Hist. N. Y. Agric. 5:121, pl. 16, fig. 1 (Description, in lombardy poplars)

1859 **Fitch, Asa.** N. Y. Agric. Soc. Trans. 1858, 18:844 (Attacks poplar, habits, description); same in Noxious and Other Ins. N. Y. 5th Rep't, p.64.

1860 **Rathvon, S. S.** Entomological essay read before the Fruit Growers Ass'n Pa. Gardeners Mo. December, 2:356-57, pl. 1, fig. 3 (Rare in Pennsylvania)

1862 **Harris, T. W.** Insects Injurious to Vegetation, ed. 3, p.106-7 (Very injurious to lombardy and American poplars)

1866 **Walsh, B. D.** Prac. Ent. Ap. 30, 1:64 (In cottonwood)

1867 **Riley, C. V.** Prairie Farmer, June 15, 19:397, p.100 (Supposed larva of this species in roots of apple)

1870 **Packard, A. S.** Borers of Certain Shade Trees, Am. Nat. Dec. 4, p.593-94, fig. 119 (Mention)

1873 **Le Conte, J. L.** New Sp. N. Am. Coleopt. pt 2, Smithsonian Miscel. Coll. 264, p.238 (Specific characters)
1877 **Provancher, *L'abbé* L.** Faune Ent. Can. 1 Coleopt. p.633 (Description, very common)
1880 **Riley, C. V.** Am. Ent. July 3, p.181 (In poplar)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)
1881 **Packard, A. S.** U. S. Ent. Com. Bul. 7, p.115, 117-18 (Injurious to cottonwoods and poplars, grub and beetle described)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:326 (Attacks poplars)
1886 **Jack, J. G.** Can. Ent. 18:23 (In Populus tremuloides)
1887 **Harrington, W. H.** Ent. Soc. Ont. 17th Rep't, p.30 (Mention)
1887 **Jack, J. G.** Ent. Soc. Ont. 17th Rep't, p.17 (In Populus tremuloides)
1889 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, p.52 (Mention)
1889 **Lugger, Otto.** Insects Affecting Poplars and Willows. Minn. Agric. Exp. Sta. Bul. 9, p.55-56 (Brief notice in cottonwood, poplar and willow)
1889 **Riley, C. V.** Insect Life, 7:164 (Review of Minn. Bul. 9)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.426, 435-36, 599 (Injuring poplar, cottonwood and willow, brief notice)
1890 **Smith, J. B.** Cat. Ins. N. J. p.211 (Not rare near the Hudson)
1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:31 (Bibliography of transformations)
1892 **Dury, Charles.** Insect Life, 5:54 (Very injurious to silver poplars at Cincinnati O.)
1893 **Bruner, Lawrence.** Insect Enemies of Ornamental and Shade Trees. Neb. State Hort. Soc. Rep't p.195-96, fig. 34, 35 (Very destructive to poplars and cottonwoods)
1895 **Hamilton, John.** Cat. Coleopt. Southwestern Pa., with notes and descriptions. Am. Ent. Soc. Trans. 22:369 (Not rare in diseased poplars)
1896 **Beutenmuller, William.** Food Habits of the North American Cerambycidae. N. Y. Ent. Soc. Jour. 4:80 (In poplar, also said to live in linden)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:146, 148 (Systematic account)
1896 **Lintner, J. A.** Injurious and Other Ins. N. Y. 11th Rep't, p.269 (On apple)
1898 **Wickham, H. F.** Can. Ent. 30:40, 42 (Specific characters, food plants)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.215 (Injures poplar and cottonwood trees); same in Ent. State Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Ins. N. J. List of Species, etc. State Bd Agric. 27th Rep't, sup. p.296 (Occasional through state in poplar and cottonwood)
1900 **Felt, E. P.** State Ent. 15th Rep't. N. Y. State Mus. Bul. 31, 5:557, 603 (Adults reared by Mr Adams from Populus monilifera July 18)

1901 ——— Am. Gardening, Aug. 10, 22:558 (Poplar borer is possibly S. calcarata, use of carbon bisulfid or potassium cyanid is advised)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed, injures poplar)
1902 **Felt, E. P.** Col. State Bd Hort. Rep't 1901, p.168-69 (Injurious character)
1902 **Joutel, L. H.** Ent. News, 13:33 (Reference)

Saperda tridentata Oliv.

Elm borer

This species is of considerable economic importance, since it is sometimes very injurious to our American elms, where it may work in association with two small curculios, Magdalis barbita Say. and M. armicollis Say. We believe that this species is responsible in a large measure for the dying condition of some of our elms, though the curculios mentioned above undoubtedly aid materially in the work of destruction.

Early history. The earliest record of injury by this insect is that given by Harris in his report, *Insects Injurious to Vegetation.* He states that trees on Boston Common "were found to have suffered terribly from the ravages of this insect. Several of them had already been cut down as past recovery; others were in a dying state; and nearly all of them were more or less affected with disease or premature decay." Dr S. A. Forbes, state entomologist of Illinois, in his 14th report, states that, from the rapid progress which this pest has made among the elms during the last two or three years, it seems extremely likely that it will totally exterminate the trees unless it be checked by general action. Dr J. A. Lintner, late state entomologist of New York, in writing of this insect in 1893, characterizes it as being generally destructive throughout the State and one worthy of close attention in order to check or to prevent its causing serious injuries. Professor Garman, entomologist of the Kentucky Agricultural Experiment Station, records an instance of serious injury by this pest to trees about the streets of Frankfort. Several trees were dead and a number of other valuable elms dying, those affected being among the largest

and the finest in the city. A more recent outbreak at Berlin Mass. was brought to the writer's attention in 1898. Two long rows of rather young elms were seriously injured by this insect and the associated Magdalis armicollis Say and M. barbita Say, and a number of the trees were killed.

Signs of attack. The presence of this insect is not easy to detect till it has become well established, and the first signs are usually seen in the lighter, thinner foliage followed by a dead limb here and there. Indications of boring soon appear, and the dark sawdust collects in crevices of the bark, and, after the attack has progressed for some time, large portions of the bark may be easily pulled from the tree, revealing a condition beneath very much like that represented on plate 11, figure 2. The inner portion of the bark may be literally a mass of mines or burrows, and, if the work has not gone too far, numerous whitish, flattened, legless grubs may be found in the channels they have excavated. The junior author is of the opinion that this species normally feeds on dead or badly diseased tissues, and that from them it may invade living bark. A small portion of the work of this insect is shown on plate 3, figure 1, where it is seen that the grubs have made incursions into the living bark, working back to that which is dead. It is also able to live in the thick bark of older trees for a portion of its life. This is undoubtedly true in some cases at least, and in others it certainly appears as though this species was the initial cause of the trouble. The observations of Mr M. F. Adams on a large number of injured trees in the vicinity of Buffalo led him to attribute the primary injury to this species.

Life history. The time necessary for this insect to complete its life cycle is unknown, but from our breeding experiments it seems that probably only one and possibly two years are necessary. The larvae commence transforming to pupae in New York State about the middle of May or earlier, and the beetles begin to appear the latter part of that month and continue to emerge for some time, examples having been taken as late as Aug. 24. The eggs are deposited on the bark in June, according to the

observations of Dr Fitch, but it would seem very probable that oviposition may occur much later, as beetles are abroad till into August. The attack usually begins at the base of the tree. The young grub works its way under the bark and begins feeding on the tissues and making a serpentine burrow. The boring increases in size with the growth of the larva [pl. 3, fig. 1], and in the course of time the tree may be completely girdled and then it must soon die. Dr Packard, writing in 1870, calls attention to finding three sizes of larvae; and we found it comparatively easy to separate those taken from a badly infested piece of limb in a similar manner. But in our breeding from such infested bark all larvae transformed the same season. We have also found it working in dead as well as living tissues and have proved its ability to complete its transformations in the former.

Food plants. This insect appears to infest the white elm almost exclusively, though Dr Fitch records it as breeding in the slippery elm. We have seen no indications of its attacking the English or Scotch elms, so common in Albany. There is a record of this species having been reared from maple, but it would seem that the infestation must have been abnormal or else the record was founded on an erroneous observation.

Description. Black, sometimes fawn color, densely covered with a gray pubescence [pl. 3, fig. 3]. Thorax: twin black spots below lateral orange red bands which are joined together at the base and reach to the head, where each divides and encircles an eye; sometimes ornamented with two black spots on each side of median line. Elytra: submarginal ridge reaching from the humeral angle to near the apex, giving them an angulated appearance; ornamented by a more or less distinct submarginal, orange red band, from which arise three crossbars of the same color, the one nearest the base of the elytra nearly transverse, except at the tip, where it is sometimes oblique, it rarely reaches to the suture and has a black spot on either side where it joins the submarginal band; the middle band oblique and usually joined at suture; the apical one also oblique, with a black spot at its posterior side, usually reaches the suture and

continues to the apex, where it joins the submarginal band. The apex is truncate and usually sinuate in well developed examples.

Distribution. The elm borer is generally distributed in New York State and has been recorded by various writers from the following additional localities: provinces of Ontario and Quebec, Massachusetts, Rhode Island, New Jersey, Pennsylvania, Ohio, Kentucky, Illinois, Michigan, Wisconsin and Iowa. It was collected by Professor Bolles in Texas and at Tyngsboro Mass. by Blanchard. We have also seen specimens from the District of Columbia. It probably occurs in a number of other states.

Remedies. Badly infested trees should be cut and burned before the beetles have had an opportunity to emerge in the spring, that is before the latter part of May, in the latitude of New York. And in a like manner infested portions of others should be cut away and burned. The latter process was carried out on a lot of 1500 elms at Buffalo N. Y. by Mr M. F. Adams, who reports that the trees were benefited in a most gratifying manner.

Protecting the trees during the period of oviposition with a carbolic acid wash has been frequently recommended, but is of doubtful utility. Where this insect is very abundant and its injuries correspondingly serious, it would do no harm to try the effects of a wash. One of the best may be prepared as follows: thin a gallon of soft soap with an equal amount of hot water and then stir in 1 pint of crude carbolic acid, or ½ pint of the refined, and allow it to set over night. The next day add 8 gallons of soft water and apply to the parts to be protected, which in the case of this insect would be the trunk and base of the lower limbs. The bark should be kept moist with this substance from the latter part of May through July.

Removing portions of the bark has also been recommended. The badly infested portion should be cut away and the grubs destroyed, and, where a few are working in living bark, it might be well to remove the upper layers till the grubs are nearly exposed and then brush over the shaven surface with strong kerosene emulsion or whale oil soap solution, finally covering the wound with a paste formed of a mixture of fresh cow dung and lime or with a coat of cheap, red paint.

Bibliography

1795 **Olivier, A. G.** Entomologie, 4:30, pl. 4, fig. 48 (Original description)
1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. 2:164 (Description)
1853 **Haldeman, S. S.** Am. Phil. Soc. Trans. n. s. 10:55 (Listed as Compsidea tridentata var. dubiosa described)
1854 **Emmons, Ebenezer.** Nat. Hist. N. Y. Agric. 5:122, pl. 34, fig. 6 (Beetle described)
1858 **Fitch, Asa.** Noxious and Other Ins. N. Y. 5th Rep't, p.59-60 (Life history, larva and adult described); N. Y. State Agric. Soc. Trans. 18:839-40
1860 **Rathvon, S. S.** Gardeners Mo. December, 2:357, pl. 1, fig. 4 (Brief general notice, rare in Pennsylvania, abundant in Missouri, female deposits about 100 eggs)
1862 **Harris, T. W.** Insects Injurious to Vegetation, ed. 3, p.111-13, pl. 11, fig. 13 (Description, ravages and notes on life history)
1869 **Packard, A. S.** Guide to the Study of Insects, p.499 (Mention as Compsidea)
1870 ——— Am. Nat. December, 4:588-91, fig. 115, 116 (Quotes Harris largely, injury in New Jersey, notes on life history, adult and larva described, and figured)
1873 **LeConte, J. L.** New Sp. N. Am. Coleopt. pt 2, Smithsonian Miscel. Coll. 264, p.239 (Specific characters)
1874 **Hubbard, H. G.** Psyche, 1:5 (Associated with Magdalis armicollis)
1877 ——— Psyche, 2:40 (In elm, as S. trilineata)
1877 **Provancher, *L'abbé*, L.** Faune Ent. Can. 1 Coleopt. p.632, 634 (Description)
1877 **Thomas, Cyrus.** Ill. State Ent. 6th Rep't, p.38, 44, 156-57 (Reference, description, often very injurious in planted groves)
1878 **Packard, A. S.** Gardeners Mo. May, 18:133 (Notes, injuries similar to those of S. tridentata)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10
1881 **Packard, A. S.** U. S. Ent. Com. Bul. 7, p.58-59, fig. 17 (Brief account)
1883 **Harrington, W. H.** Ent. Soc. Ont. 14th Rep't, p.35 (Pupae taken from prostrate maple)
1883 ——— Can. Ent. 15:79 (Pupae in prostrate maple)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:326 (Described on elm)
1885 **Forbes, S. A.** Ill. State Ent. 14th Rep't, p.112-14 (Injuries in Illinois, larva and beetle described, preventive measures)
1887 **Harrington, W. H.** Ent. Soc. Ont. 17th Rep't, p.30-31 (Pupae in maple)
1889 ——— Ent. Soc. Ont. 20th Rep't, p.52 (In elm)
1890 **Caulfield, F. B.** Ent. Soc. Ont. 21st Rep't, p.73-74 (Brief general notice)
1890 **Harrington, W. H.** Can. Ent. 22:186 (Listed from counties of Argenteuil and Ottawa)

1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.224-26, fig. 71, 424 (General account, largely after Professor Forbes)
1890 **Perkins, G. H.** Vt. Agric. Exp. Sta. 3d Rep't, p.154-55 (Brief general notice)
1890 ——— Vt. State Bd Agric. 11th Rep't, sep. p.68-71, fig. 52 (Brief general account)
1890 **Smith, J. B.** Cat. Ins. N. J. p. 212 (Common at Newark, Caldwell)
1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:31-32 (Bibliography of transformations)
1893 **Garman, H.** Ky. Agric. Exp. Sta. Bul. 47. 1893. p.44-50; also in 6th An. Rep't. 1894. p.122-27, fig. 12, 13 (Injuries in Frankfort, general account)
1893 **Lintner, J. A.** Garden and Forest, 6:76 (Injurious work in New York State, remedial measures)
1893 ——— Injurious and Other Ins. N. Y. 9th Rep't, p.427-28 (Injurious work in New York State, remedial measures); same in West. N. Y. Hort. Soc. Proc. 1893, sep. p.7-8
1894 ——— Albany Evening Jour. May 7 (Brief general notice)
1895 **Hamilton, John.** Am. Ent. Soc. Trans. 22:369 (Common on elm)
1895 **Lintner, J. A.** Injurious and Other Ins. N. Y. 10th Rep't, p.484, 485, 499 (Reference)
1896 **Beutenmuller, William.** Food Habits of the North American Cerambycidae. N. Y. Ent. Soc. Jour. 4:80 (In elm)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 150 (Systematic account)
1896 **Lintner, J. A.** Country Gentleman, Sep. 24, 61:746 (Injuries in Illinois, remedies)
1897 ——— Injurious and Other Ins. N. Y. 12th Rep't, p.239, 243-48, 355 (Detailed account); also in N. Y. State Mus. 50th An. Rep't
1898 **Felt, E. P.** A Pernicious Elm Borer. Country Gentleman, 63:869 (Injuries at Berlin Mass., notes on life history); same in N. Eng. Farmer, Nov. 26, p.2
1898 ——— Elm Borer. Country Gentleman, Nov. 17, p.906 (Remedial measures)
1898 ——— N. Y. State Mus. Bul. 20, p.19-20, fig. 6 (Brief notice)
1898 ——— State Ent. 14th Rep't, N. Y. State Mus. Bul. 23, p.245, 256 (Reference)
1899 ——— N. Y. State Mus. Bul. 27, p.49 (Mention)
1899 **Garman, H.** Ky. Agric. Exp. Sta. Bul. 84, p.60, fig. 7 (Mention)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.215 (Mention); same in Ent. State Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Cat. Ins. N. J. State Bd Agric. Rep't, sup. p.297 (On elm)
1900 **Felt, E. P.** Fish. Game and For. Com. N. Y. 5th Rep't, p.371-75, pl. 3, fig. 1-4 (General account)
1900 ——— State Ent. 15th Rep't. N. Y. State Mus. Bul. 31, p.556 (Work on elms, emergence of beetles), p.581-82 (Brief notice), p.589, 592 (Reference)
1900 ——— N. Y. State Mus. Bul. 37, p.22, fig. 32 (Brief notice)

1901 ——— State Ent. 16th Rep't. N. Y. State Mus. Bul. 36, p.1006, 1007 (Biologic data from M. F. Adams)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed, serious injuries)
1902 **Felt, E. P.** State Ent. 17th Rep't. N. Y. State Mus. Bul. 53, p.863 (Principal references)

Saperda cretata Newm.

Spotted appletree borer

This insect is the more common appletree borer in Michigan, where it inflicts serious injuries according to Professors Cook, Riley and Osborn. It is probably this insect that Mr L. J. Templin had in mind in 1877 when writing of the appletree borer in the *Practical Farmer* for Nov. 17. He states that in the West a "majority of the specimens have a spot on each elytron on the shoulder," and shows that it was quite injurious even at that early date. It also works in the lower limbs of Crataegus, as stated by Dr Hamilton. Professor Osborn has recorded this insect as inflicting considerable injury in Iowa.

Description [pl. 4, fig. 2]. Cinnamon brown with a white band on the side of thorax, and a large, oblong white spot twice as long as wide, at middle of each elytron, and another small spot before apex; neither reaching to suture or margin. There is sometimes a minute white spot at middle of base of thorax as well as at the humeral angles. The sides are white; underneath, brown.

Distribution. This species has been recorded from the following localities: Paris Ont. [E. B. Reed], New York and Pennsylvania [Hamilton], New Jersey and Ohio [Chittenden]; Mr Chittenden states that there are specimens of this insect in the United States National Museum from northern Illinois and Texas; Leng and Hamilton record it from the following localities: Massachusetts, Canada, Michigan, Wisconsin, Iowa, Illinois and Pennsylvania; and Mr Wenzel informs us that he has recently taken it at Philadelphia. Mr Blanchard took it at Tyngsboro Mass.

Food plants. This species, in addition to the apple, attacks wild crab apples, and it has been observed on Juneberry [Chittenden].

Life history. Professor Osborn has observed the work of this insect quite closely. He states that its attack is usually confined to branches of moderate size, and that its plan of work is somewhat peculiar. At intervals of half an inch or more along the branch double incisions are made in the bark; and, on cutting these away, it was found that they led to excavations of considerable size under the bark, in some of which small grubs could be found at work. The borers had the appearance of the common appletree borer and were evidently of one year's growth. This insect makes a longer, more tortuous burrow than c a l c a r a t a, in our experience. Its work in thorn is represented on plate 4, figure 1.

The pupa as described by Professor Osborn is similar to that of S. c a n d i d a but smaller and occupies the central portion of the branch. He further observes that the beetles issue about the middle of June, and, after pairing, the female lays her eggs in the bark, two in a place, distributing them along the branch at distances of half an inch to an inch. On hatching, the grubs work in opposite directions around the branch, living for the first year just beneath the bark and afterward entering the solid wood. Here, after becoming full grown, they pupate and in due time complete their transformations.

Remedies. The remedial measures advised by Professor Osborn are cutting out and destroying the grubs with as little injury to the bark as possible; and, as he observes, if this is done soon enough, two grubs may be killed at every incision. He also states that some of the smaller woodpeckers are likely to prove most effectual allies in controlling this insect, and their presence in an orchard should be encouraged. Professor Cook has advised the use of the carbolic soap wash, which he states should be applied about June 10.

Bibliography

1838[1] **Newman, Edward.** Ent. Mo. Mag. 5:396 (Original description)
1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. 2:164 (Description)
1868 **Reed, E. B.** Can. Ent. 1:19 (Rare at Paris Ont.)

[1]Reference unverified.

1880 **Osborn, Herbert.** New Enemy to Appletrees. West. Stock Jour. and Farmer, December, 10:273-74 (Characters, habits and means against)
1881 **Cook, A. J.** Can. Ent. 13:191 (Injuring appletrees in Michigan, carbolic soap wash)
1881 **Osborn, Herbert.** Ia. State Hort. Soc. Trans. 1880, 15:11-13, figure (Description, life history and remedies)
1881 ——— Am. Nat. March, 15:244 (Oviposition, work of larva)
1882 **Lintner, J. A.** Injurious and other Ins. N. Y. 1st Rep't, p.331 (Listed on apple)
1888 **Cook, A. J.** Mich. State Bd Agric. 27th Rept, p.168, fig. 6 (More common than S. candida, description, remedy)
1889 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, p.52 (In appletrees)
1891 **Cook, A. J.** *& others.* Insect Life, 3:249 (Prefers branches)
1895 **Hamilton, John.** List Coleopt. Southwest. Pa. etc. Am. Ent. Soc. Trans. 22:369 (Common in limbs of crataegus)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 149 (Systematic account)
1896 **Lintner, J. A.** Injurious and Other Ins. N. Y. 11th Rep't, 1895, p.269 (Listed on apple)
1898 **Chittenden, F. H.** U. S. Dep't Agric. Div. Ent. Circ. 32, June, p.8, fig. 2 (Description, injuries, distribution, habits)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Specific characters, food plants)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, December, p.215 (Attacks apple and thorn); same in Ent. State Exp. Sta. 5th Rep't, p.131

Saperda discoidea Fabr.

Hickory saperda

This species is remarkable in having the sexes so unlike that one unacquainted with it would certainly consider them distinct species. In a long series of males, however, there will be found individuals having the same color and markings as the females, and some very poorly developed females lack entirely the characteristic markings of the sex. This is a common insect and breeds abundantly in hickory, frequently following the work of the destructive hickory bark borer, Scolytus quadrispinosus Say. It is sometimes so abundant that a piece of bark 6 inches square may contain a dozen or more larvae.

Life history. The beetles have been taken abroad the latter part of June and in July. The larvae feed partly on the bark and partly on the wood and on approaching maturity, in our

experience, enter either the bark or the wood and transform to beetles. The work of this species is shown on plate 3, figure 2. Dr Hamilton has found more than 20 larvae, pupae and immature beetles, in the bark of a large hickory that had been killed about two years before. All were on the north side of the tree and none over 15 inches from the ground. In our experience they are equally abundant on all sides of the tree but appear to avoid any part infested by a dense white fungus growing between the bark and wood and often into the wood, and as very often only one side of the tree is so affected, this may account for the experience of Dr Hamilton. Dr Horn states that the larvae fed on the outer layers of the wood till they had attained nearly full growth and then retired into the bark, closing their burrows and transforming like a species of Urographis in oak.

Food plants. This insect appears to confine its attack to diseased or dying trees. We have reared it from trees killed by Scolytus quadrispinosus Say. It has been recorded on the hickory by Mr Harrington and as common on hickory and walnut in southwestern Pennsylvania by Dr Hamilton.

Description [pl. 3, fig. 5, 6]. Color above varies from black to light reddish brown in some examples; thorax and elytra strongly punctate; legs reddish brown, darker toward the tarsi. The under side is white in the males and light yellowish gray to light gray in the females.

Female. Head and thorax covered with olive yellow hair; scutellum yellow; the elytra denuded, except a small spot above and one below; a crescent-shaped fascia in the middle of each elytron, composed of dense yellow hair, which also forms a marginal band spreading over the apical end of the elytra.

Male. Uniformly ferruginous, black above, covered by a sparse gray pubescence that forms a whitish line on the sides and dorsum of the thorax, which is bordered by a denuded area.

Distribution. Middle states [LeConte]; Buffalo N. Y. [Zesch-Reinecke]; never plentiful about Hamilton Ont., though the females are usually the more numerous [Moffat]; very rare at Ottawa Can. [Harrington]; locally not rare throughout New Jersey [Smith]; and from Canada, New York, Pennsylvania,

New Jersey, Louisiana, Kansas, Nebraska, Illinois, Michigan [Leng-Hamilton].

Natural enemies. Mr Harrington has observed a species of Arotes ovipositing in infested hickories and it is possibly a parasite of this borer.

Bibliography

1798 **Fabricius, J. C.** Ent. Syst. sup. p.147 (Original description)
1801 ——— Syst. Eleu. 2:322 (Description, habitat)
1826 **Say, Thomas.** Acad. Nat. Sci. Jour. 5:273 (Described as S. fuscipes); same in Ent. North Am. Compl. Wr. 1883. 2:331.
1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. 2:163 (Description, Middle states, on walnut)
1853 **Haldeman, S. S.** Am. Phil. Soc. Trans. n. s. 10:56 (As Stenostola fuscipes var. dorsalis)
1856 **Fitch, Asa.** N. Y. State Agric. Soc. Trans. 16:440 (Attacks hickory, beetle described); same in Noxious and Other Ins. N. Y. 3d Rep't, p.122
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)
1882 **Moffat, J. A.** Can. Ent. 14:58 (Never plentiful about Hamilton Ont.)
1884 **Harrington, W. H.** Can. Ent. 16:102 (On hickory, June, rare)
1885 **Hamilton, John.** Can. Ent. 17:47 (In diseased or dead hickory or walnut, pupate in bark, beetles in May)
1887 **Harrington, W. H.** Ent. Soc. Ont. 17th Rep't, p.30 (Mention)
1889 ——— Ent. Soc. Ont. 20th Rep't, p.52 (Attacks hickory)
1890 **Smith, J. B.** Cat. Ins. N. J. p.212 (Not rare on hickory)
1891 **Harrington, W. H.** Ent. Soc. Ont. 21st Rep't, 1890, p.68 (Arotes ovipositing in infested hickories)
1895 **Hamilton, John.** List Coleopt. Southwest. Pa. etc. Am. Ent. Soc. Trans. 22:369 (Common on hickory and walnut)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (In hickory)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 150 (Systematic account)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Specific characters, food plants)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, December, p.213 (On hickory); same in Ent. State Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Cat. Ins. N. J. State Bd Agric. Rep't, sup. p.297 (Throughout the state, locally not rare in hickory)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed)

Saperda vestita Say

Linden borer

This species is a serious enemy of lindens in this country and is therefore one of considerable economic importance.

Early history. Dr Harris has recorded extensive depredations on linden trees in Philadelphia by an insect supposed to belong

to this species, but, as the workings are very different from any we have met with, we question the identity of the depredator. The trouble was so serious that 47 trees were cut down by order of the authorities. The nature of the injury may be judged by the following. One of the infested lindens was very large, the trunk measuring 8 feet, 5 inches in circumference 5 feet from the ground. A strip of bark 2 feet wide at the bottom and extending to the top of the trunk was destroyed, and the exposed surface of the wood pierced and grooved with countless numbers of holes where borers had bred and where swarms of the beetles were supposed to have issued in past times. Some of the larger limbs and a portion of the tree broke off, apparently the consequence of the ravages of this insect. This pest has been very injurious to the European linden at Cambridge Mass., and Professor Webster has recorded it as damaging young lindens in nursery rows.

Life history. The beetles appear toward the end of the summer (we have taken them in August) and feed on the bark and the leaf petioles and also the larger veins on the under side of the leaves and on the green bark of the growing shoots, often killing the tips of the branches. When the beetles are very abundant, the injury caused by them is quite noticeable. Professor Smith has observed this beetle abroad in New Jersey during July, and Dr Packard states that one female may contain as many as 90 eggs. A female is said to deposit her eggs, two or three in a place, on the trunk and branches, specially about the forks, making slight incisions and punctures for their reception with her strong jaws. The larvae undermine the bark for a distance of 6 or 8 inches from the place where they hatch and often penetrate the wood to an equal extent, as stated by Dr Packard, who adds that this insect works at the base of young lindens, gouging two parallel rings around the trunk and forming annular swellings. We have observed the work of this species and seldom found it more than 12 inches above the ground; and in our experience it occurs very largely in exposed roots and subterranean parts, though Mr D. B. Young states that he has taken this beetle from galleries in the lower limbs of a large

tree. The method of work is shown on plate 5, figure 1, which represents the broad galleries of the larva and the exit hole of the beetle. Our observations are confirmed by Professor Webster, who also states that the pupal cell is made at about the level of the ground and is cut diagonally across the grain of the wood and at an angle of about 45° to the channel the larva makes when ascending to this level.

Food plants. Linden is the greatest sufferer from the ravages of this insect, though it has been recorded by Dr Packard as infesting poplar, as occurring on ? elm by Riley and Howard, and Rev. J. L. Zabriskie has taken the insect from appletrees. It is doubtful, in our judgment, if the insect breeds in other than the various lindens.

Description [pl. 5, fig. 5]. Black, covered by a dense olivaceous pubescence, usually with three denuded spots on each elytron, two placed obliquely above the middle and one below. One or all of these spots may occasionally be wanting.

Distribution. This insect has been recorded from localities as follows: Lake Michigan [Say]; rare in Massachusetts [Harris]; very abundant in Lancaster county, Pa. [Rathvon]; Middle and Western states [LeConte]; Amherstburg Ont. [E. B. Reed]; Buffalo [Zesch-Reinecke]; L' Original and Grenville Can. [Harrington]; rather common in New Jersey [Smith]; not rare on linden in southwestern Pennsylvania [Hamilton]; very common [Provancher]; Canada, Vermont, New Hampshire, Massachusetts, New York, Pennsylvania, Michigan, Wisconsin, Iowa, Illinois, Ohio, New Jersey [Leng-Hamilton]. We have also seen specimens from Missouri.

Natural enemies. Two enemies have been bred from this species, one, Bracon pectinator Say? from the insect in ? elm and another, B. charus Riley, which is given by Dr Packard on the authority of Riley's unpublished notes, and, as no food plant is given, it is possible that the latter is but a different name for the insect previously mentioned.

Remedies. It is manifestly impossible to attempt to control this insect on other than valuable trees, and in such situations, digging

out the borers, with possibly recourse to the use of repellent washes described on page 29, is about all that can be done and in the majority of instances should afford considerable protection.

Bibliography

1824 **Say, Thomas.** Narrative of an Expedition to the Source of St Peters River (Long's second expedition), p.290 (Original description, habitat southern extremity Lake Michigan and Philadelphia); same in Compl. Wr. 1883. 1:193

1844 **Harris, T. W.** Farmers Cab. and Am. Handbook, 8:213-14 (Observations on, means against, rare in Massachusetts)

1844 ——— Hovey's Mag. Hort. September, 10:330-33, figures (Habits and ravages, figures of the larva, pupa and imago)

1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. 2:163 (Description, Middle and Western states)

1853 **Haldeman, S. S.** Am. Phil. Soc. Trans. n. s. 10:55 (Listed)

1854 **Emmons, Ebenezer.** Nat. Hist. N. Y. Agric. 5:121, pl. 34, fig. 4 (Described, attacks linden)

1860 **Rathvon, S. S.** Entomological essay read before the Fruit Growers Ass'n East. Pa. Gardeners Mo. December, 2:356, pl. 1, fig. 2 (Injury in Philadelphia and brief notice)

1862 ——— Com. patents Rep't, 1861, Agric. p.618-19, fig. 79, 80 (Injuries at Boston and Philadelphia, very abundant in Lancaster county, Pa.)

1868 **Reed, E. B.** Can. Ent. 1:19 (Taken at Amherstburg Ont.)

1870 **Packard, A. S.** Am. Nat. 4:591-93, fig. 117, 118 (Natural history, ravages)

1877 **Provancher,** *L'abbé* **L.** Faune Ent. Can. 1 Coleopt. p.634 (Description very common)

1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)

1881 **Packard, A. S.** U. S. Ent. Com. Bul. 7, p.123, 124-25, fig. 59 (On poplar, linden, brief notice)

1884 **Dimmock, George.** Stand. Nat. Hist. 2:326 (Described, attacks linden)

1887 **Harrington, W. H.** Ent. Soc. Ont. 17th Rep't, p.30 (Mentions the linden borer)

1888 **Lintner, J. A.** Injurious and Other Ins. N. Y. 4th Rep't, p.207 (Reference)

1890 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, 1889, p.52 (In linden)

1890 ——— Can. Ent. 22:186 (Taken at L'Original and Grenville Can.)

1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.226 (On elm, Bracon charus Riley a parasite), p.474-75, fig. 171 (Brief notice, in linden)

1890 **Riley, C. V. & Howard, L. O.** Insect Life, 2:348 (On elm, Bracon pectinator ? Say, bred from)

1890 **Smith, J. B.** Cat. Ins. N. J. p. 212 (Rather common in linden)

1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:31 (Bibliography of transformations)

1891 **Caulfield, F. B.** Ent. Soc. Ont. 21st Rep't, 1890, p.74 (Reference)
1895 **Hamilton, John.** List Coleopt. Southwest. Pa. Am. Ent. Soc. Trans. 22:369 (Not rare on linden)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (In linden)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 149 (Systematic account)
1896 **Lintner, J. A.** Injurious and Other Ins. N. Y. 11th Rep't, 1895, p.269 (On apple)
1896 **Zabriskie, J. L.** N. Y. Ent. Soc. Jour. 4:96 (Dug from an appletree)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Description, food plant)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, December, p.215 (Mention); same Ent. State Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Cat. Ins. N. J. State Bd Agric. 27th Rep't, sup. p.297 (Lindens often seriously injured, beetles in July)
1900 **Ehrmann, G. A.** Ent. News, 11:621 (Feeding on linden foliage, Pittsburg Pa.)
1901 **Webster, F. M.** Ent. Soc. Ont. 31st Rep't, 1900, p.81-83, fig. 42-43 (Injuries, nursery stock affected)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed)

Saperda imitans n. sp.

This interesting species resembles our common elm borer, S. tridentata, with which it has frequently been confused. The junior author bred this insect some years ago from wood collected near the city of New York, but he did not notice that it was distinct from our common elm borer till too late to examine its workings. He had no elm in the breeding cage at the time, and so presumes that it lived in hickory, of which he had a quantity.

Description [pl. 3, fig. 4]. Black, densely covered with a gray pubescence, whiter below. Thorax: twin black spots below a lateral orange red band, extending on the head to the eyes, where it joins the line of the opposite side; median line light. Elytra: submarginal band of orange red running to the apex, from which arise three crossbars of the same color, each obliquely inclined toward the suture, the middle band usually not connected to the submarginal, the apical band usually rudimentary and then only transverse; apex rounded.

Types in collection of L. H. Joutel and New York State collection.

This insect is often mistaken for tridentata, but can be easily separated by the following characters, which show it to be

distinct and not even closely related. It is longer in proportion to its width than tridentata. The sides are parallel, while in tridentata the humeral angle is quite pronounced. The first crossbar is oblique, there are no spots on each side of it, and the spot is also lacking behind the apical crossbar; it also wants the submarginal carina present in tridentata, which has the first crossbar at right angles. The pygidium of the female is broader at the top, and the sides make a wider angle than that of tridentata.

Distribution. This species has been received from Montreal Can.; and Mr Fred Blanchard has taken a specimen at Tyngs-

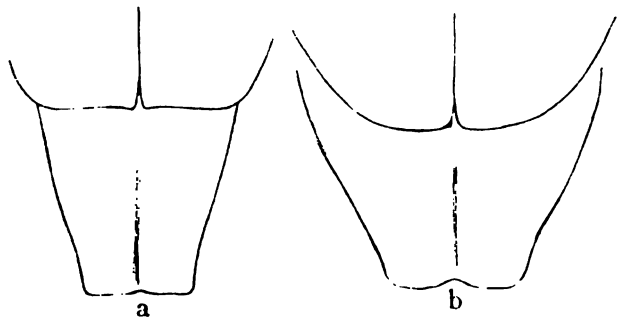


Fig. 5 Last dorsal segment and apex of elytra of S. tridentata (*a*) and S. imitans (*b*)

boro Mass. Mr Roland Haywood has taken it near Boston; specimens have been seen from Virginia, Michigan, Pennsylvania and Wisconsin; and we have bred it from New York city and vicinity.

Saperda lateralis Fabr.

Red-edged Saperda

This species is about the same size as S. tridentata Oliv. and like it occurs in elm. Its principal food plant is hickory, on which it is partial to injuries near the roots and to the base of sprouts on recently cleared lands. It is rarely abundant enough, however, to cause serious injury.

Life history. Comparatively little has been published concerning the life history of this species. The beetles may be taken in June in northern localities, and, like most other Saperdas,

feed on the bark and petioles of the leaves at the ends of the shoots. Mr Tolman found them pairing in June on a fallen hickory near Philadelphia. We have bred this species from hickory stems in which the larvae lived at the juncture of the dead and living bark. Mr S. T. Kemp records the fact that he found the larvae of this species inhabiting the base of dead shoots of hickory, and, on breaking off the shoots, the borers were almost entirely exposed, sometimes falling to the ground. The infested shoots were invariably those which had been broken off 3 or 4 feet above the ground by the larvae of Elaphidion villosum Fabr. the previous season. The grubs of these work at the very base of the tree and burrow almost laterally and slightly upward. In addition to food plants mentioned above, Dr Packard records breeding the species from alder, but this appears to be exceptional.

Description [pl. 7, fig. 8]. Black, sometimes brownish black, coarsely punctured and covered with brownish black pubescence above and gray below. Antennae black; thorax with two black spots below, a lateral orange red band that extends on the head to the eyes and joins at the apex; the elytra have a submarginal band that connects with the thoracic one at the humeral angle and at the rounded apex joins a sutural band, which is sometimes wanting. This species is remarkable in that the male possesses a tooth or process on all its claws.

Connecta n. var. [pl. 7, fig. 9]. Like the species in color but lacks the sutural line; the submarginal band extends to the margin; and it has three oblique lines on the elytra, the apical one rudimentary and the middle one broad. Dr Fitch has described two varieties, abbreviata and suturalis, which are characterized simply on the width of the sutural and submarginal stripe. Types in the collection of L. H. Joutel.

The variety connecta is connected with the species by intermediate forms in all stages of development, from those that have a slight mark at the marginal band or at the sutural one or both, to those that have the two bands in various stages of development [fig. 6].

Like imitans, this variety has been confused with tridentata, which it somewhat resembles. It can be easily separated from that species and imitans by the punctures, the brownish black pubescence above; the shape of the elytra and the rounded head. This form occurs with the type and is more common westward.

Distribution. This insect has been recorded from the following localities: Cliftondale Mass. [Henshaw], Buffalo N. Y. [Zesch-Reinecke], Philadelphia Pa. [Tolman], Hull and Ottawa Can. [Harrington], Montreal Can. [Caulfield], Providence R. I. [Packard]; is not rare in southwestern Pennsylvania [Hamilton]; Canada, Vermont, Massachusetts, New York, Pennsylvania,

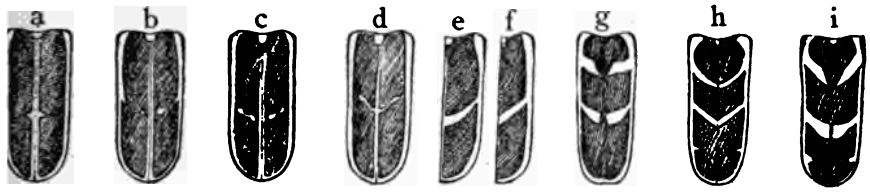


Fig. 64, *i* S. lateralis var. connecta. *a-g* intermediate variations between S. lateralis and var. connecta

New Jersey, Virginia, West Virginia, Ohio, Michigan, Wisconsin, Illinois, Iowa [Leng-Hamilton]. We have taken or bred it from Fort Lee N. J., Bronx park New York city, and Brooklyn N. Y.; it is also found in Nebraska and Massachusetts, and is common in Kansas. The variety connecta is occasionally found in New York and Massachusetts and in numbers in Kansas, Nebraska, Illinois and Wisconsin.

Bibliography

1781 **Fabricius, J. C.** Sp. Ins. etc. p.233 (Description, habitat)
1787 ——— Mantissa Ins. 1:149 (Described)
1792 ——— Ent. Syst. Emendata et Aucta, tom. 1, pars 2, p.312 (Description, habitat)
1795 **Olivier, A. G.** Entomologie, 4:17, pl. 4, fig. 41
1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. ser. 2, 2:164 (Description, distribution)
1853 **Haldeman, S. S.** Am. Phila. Soc. Trans. n. s. 10:55 (Listed as Compsidea lateralis)

1858 **Fitch, Asa.** Noxious and Other Ins. N. Y. 5th Rep't, p.60-61 (Habits and varieties); same in N. Y. Agric. Soc. Trans. 18:840-41
1869 **Walsh, B. D. & Riley, C. V.** Am. Ent. April, 1:168 (Attacks elm)
1874 **Henshaw, Samuel.** Psyche, 1:23 (Taken June 12 at Cliftondale Mass.)
1877 **Provancher, *L'abbé*, L.** Faune Ent. Can. 1 Coleopt. p.633, 635 (Description)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)
1881 **Packard, A. S.** U. S. Ent. Com. Bul. 7, p.59 (In elm), p.141 (In alder)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:326 (On elm)
1889 **Tolman, Adams.** Insect Life, 1:343 (On hickory)
1890 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, 1889, p.52 (Attacks elm)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.226 (In elm), p.636 (In alder)
1890 **Smith, J. B.** Cat. Ins. N. J. p.212 (On hickory, common)
1891 **Caulfield, F. B.** Ent. Soc. Ont. 21st Rep't, 1890, p.74 (Attacks elm)
1895 **Hamilton, John.** Cat. Coleopt. Southwest. Pa. Am. Ent. Soc. Trans. 22:370 (Not rare on elm and hickory)
1895 **Harrington, W. H.** Ent. Soc. Ont. 25th Rep't, 1894, p.48 (Taken June 24 near Hull)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (In hickory)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 150-51 (Systematic account)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Description, food plants)
1899 **Kemp, S. T.** Ent. News, 10:108 (Follows Elaphidion in hickory shoots)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed, on hickory)

Saperda fayi Bland.

Thorn limb borer

This species breeds in the small limbs and stems of wild thorn (Crataegus crus-galli and C. tomentosa), creating gall-like, gnarly swellings and weakening the branches so that they sometimes break off in the wind. This insect is widely distributed in New York State, though quite local. It displays a marked fondness for certain trees, in which it will breed year after year while others near by will be practically unaffected. Should this species, like its allies, acquire a taste for our cultivated fruit trees, it would never prove as dangerous an enemy

as the round-headed appletree borer (S. c a n d i d a Fabr.) as the galls would indicate the injury and could easily be cut off.

Life history. The beetles [pl. 6, fig. 4] appear in New York State during the month of June, the exact date varying according to the season, the males preceding the females by three or four days. They do not appear to eat and are short-lived, while the whole brood, excepting the stragglers, appear and disappear within the space of 10 or 12 days, so that close observation is necessary in order to capture many. The late Dr J. A. Lintner has taken this species June 25 at Schenectady, and Mr Moffat collected beetles at Hamilton Ont. June 15, while Mr Zimmerman records the capture of a female Aug. 15.

The males watch for the appearance of their consorts and pairing usually lasts three or four hours, according to Dr Hamilton. The beetles fly but little and usually oviposit on the tree they inhabited as borers, which explains the local character of the species. The insects are sluggish and, when suddenly approached, drop to the ground and endeavor to conceal themselves. Egg-laying probably occurs during the night, though the process has not been observed. Small limbs, varying in size from $\frac{1}{3}$ to $1\frac{1}{2}$ inches in diameter, are selected for this purpose, and, according to the thickness of the limb, the female uses her mandibles to make from three to six longitudinal insertions through the bark, each being about $\frac{3}{4}$ inch in length, parallel to one another and dividing the circumference of the trunk or limb into nearly equal sections. An egg is deposited in each of these slits, and as soon as hatched the larva at once makes a burrow beneath the outer layer of the wood, perhaps $\frac{1}{8}$ inch in length, and uses this as a retreat from which it issues to feed on the wounded tissue caused by the irritation. These slits and the irritation caused by so much cutting produce an increased flow of sap to the wound and a consequent thickening of the portions between the slits, so that the affected part soon assumes a gall-like appearance.

The work of this species is shown on plate 6, which represents a twig on the lower portion of which are two old galls with irregular, decaying, overgrown cavities [fig. 1], which are quite different from more recent galls [pl. 6, fig. 2]. The borings of

the larva in a young gall are shown in section on plate 7, figure 2, and the manner in which the stem may be eaten by a larva working in its center at figure 2a [*See also* pl. 13].

The larvae are ¼ inch long on the approach of winter, according to Dr Hamilton's observations, when they retire into the wood a little farther and close the opening of their burrows with borings. One of the larvae, and in thick limbs two or three, bore obliquely till one of them reaches the center of the limb, up which it proceeds often two or three inches. The others parallel this gallery but maintain a partition between the burrows. The larvae near the center are much larger, often twice the size of those inhabiting the outer wood, and are the only ones that produce beetles, as stated by Dr Hamilton. In our experience the different sized larvae indicate male and female and unless parasitized all emerge.

We can not entirely agree with the following observations regarding this species also by Dr Hamilton:

The whole of the interior of the limb is now dead wood inclosed by a growth of living but unsound woody tissue, through which some openings remain. Many of the larvae in the outside wood perish during the winter, and the survivors, after feeding a while in the spring, likewise die, their mission seeming to have been merely to insure a sufficiency of dead wood to sustain the life of the favored few destined for full development.

The larvae in the deep wood return in the spring and feed on the dead tissues, which are now abundant enough for all their wants, and by autumn they are nearly full grown. Some of the larvae do not return in the spring of the second year to feed on the dead wood at the entrance of the burrow, but bore directly up and down the center of the limb for a distance of 16 to 24 inches before pupating. Those which feed on the dead wood near the entrance to the wound are nearly full grown by autumn. They again retire for the winter and in the spring, after opening up communication with the outside world, feed for a short time and when full grown measure about ¾ inch in length. They now return to their burrows for the final transformations. Some of

them bore for at least six inches, while others scarcely go from the entrance more than twice their own length. The outer ends of the burrows are closely packed with borings without and soft fibers within, which also fill the inner ends. The head of the larvae may be either toward or away from the opening, seemingly a matter of indifference. In the former case the beetle emerges from the place of entrance and in the latter, from a round hole at right angles to the burrow, probably made by the beetle itself, as no such hole has been detected in the many limbs Dr Hamilton examined, containing pupae with their heads turned from the opening. Pupation occurs after the middle of April. We have found them transforming at Albany Ap. 16. The beetles may be found in the limbs about the first of May, though but few of them emerge till the latter part of the month.

Description [pl. 6, fig. 4]. Cinnamon brown, below gray, white at sides, being of the same color as cretata. Thorax with lateral white band that extends on to the base of the elytra, which also have two crescent-shaped, white spots at middle, divided by the suture, and two smaller circular ones near the apex, also divided by suture. These spots may be nearly or quite obsolete, usually in the male. The antennae darker than cretata.

Distribution. This insect has been recorded from Buffalo N. Y. [Zimmerman]; Hamilton Ont. [Moffat]; and Dr Hamilton reports it as common in Crataegus limbs in southwestern Pennsylvania. The types were described from Ohio; Dr Smith has recorded it from Greenwood Lake and Delaware Gap N. J., and it has been listed by Messrs Leng and Hamilton from Canada, New York, New Jersey, Pennsylvania and Ohio.

This species is not related to cretata, which it resembles in color, but has more of the characters of the less specialized species, as is shown by the short, rounded head and the but slightly developed process on the claws, that on the first pair being very rudimentary. This relationship is further emphasized by its gall-producing larva working in the same way as concolor.

Natural enemies. There are no records of any, but the species appears to be a favorite with some woodpeckers, since we have found a number of empty galls showing the characteristic work of these useful birds [pl. 13, fig. 1]. We have no clue to the identity of the species.

Bibliography

1863 **Bland, J. H. B.** Ent. Soc. Phila. Proc. 2:320-21 (Original description)
1878 **Zimmerman, C. D.** Can. Ent. 10:220 (On wild thorn, Crataegus crus-galli, C. tomentosa)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)
1881 **Moffat, J. A.** Can. Ent. 13:175 (Abundant though usually rare on thorn)
1882 ——— Ent. Soc. Ont. 12th Rep't, 1881, p.29-30 (Abundant though usually rare at Hamilton)
1888 **Hamilton, John,** Can. Ent. 20:6-8 (Life history, distribution)
1888 ——— Ent. Soc. Ont. 18th Rep't, 1887, p.41-42 (Life history, distribution)
1889 ——— Can. Ent. 21:104-5 (Habits of larva in spring of second year)
1889 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, p.52 (Works in small limbs of thorn trees)
1890 **Smith, J. B.** Cat. Ins. N. J. p.212 (Listed)
1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:32 (Bibliography of transformations)
1895 **Hamilton, John.** List of Coleopt. Southwest Pa. etc. Am. Ent. Soc. Trans. 22:369 (Common in limbs of Crataegus)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (In thorn, Crataegus)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 149 (Systematic account)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Description, food plants)
1899 **Smith, J. B.** Ins. N. J. State Bd Agric. 27th Rep't sup. p.297 (Listed)

Saperda puncticollis Say

Woodbine borer

This is one of the smallest and also the prettiest species belonging to this important genus. It is a rare form in most collections in spite of the fact that the insect lives in the dead branches of the common Virginia creeper, pupating in the wood. The manner in which the larva works just under the bark is shown on plate 6, figure 6. The entrance to the pupal chamber is stopped with a plug of borings

[pl. 6, fig. 8, 8a]. The general appearance of the larva is also represented. This species seems to be somewhat retiring in habit, and, while it has been collected on the leaves of its food plant, specimens are much more easily obtained by rearing the insects from infested twigs. We have often bred the species from Virginia creeper and have frequently examined much poison ivy where the insect was abundant, but have been unable to find it in that plant. We have taken it in June and July, and Mr Zimmerman records its capture at Buffalo in June. It is probably abroad during most of the two months.

Food plants. It has been recorded on poison ivy [Zimmerman], grape and probably Virginia creeper [Harrington], Rhus toxicodendron and R. radicans [Smith], as not common on Rhus radicans in southwestern Pennsylvania [Hamilton], as bred from the larger living stems of Virginia creeper [Harrington], and as in the stems of poison ivy and oak [Lugger].

We find that the larvae feed on the inner bark of the branches and stems of Virginia creeper. This species is very subject to attack by woodpeckers, and we have seldom found the workings without evidence that a number had been destroyed by the birds.

Description [pl. 6, fig. 9]. Black, with a sparse black pubescence above and a dense gray one underneath. Head yellow with a round black spot in front and one on the vertex, antennae black; thorax yellow with a black spot at the side and four quadrately arranged on its dorsum; elytra with a broad, yellow marginal and a sutural band. The process is found only on the anterior claws of the middle pair of legs.

Distribution. It was described by Say from Arkansas; it has been taken about Buffalo by Zimmerman; about Ottawa Can. by Harrington; is reported by Smith as occurring throughout New Jersey; and by Hamilton as not common in southwestern Pennsylvania. LeConte gives its distribution as the Middle, Eastern and Western states; and Leng and Hamilton record it from the following localities: Massachusetts, New York, New Jersey, Pennsylvania, Ohio, Louisiana, Arkansas, Kansas, Nebraska.

We have bred it from stems of Virginia creeper gathered in and around New York city and also at Fort Lee N. J. It was described from Cambridge Mass. as S. trigeminata by Randall.

Bibliography

1824 **Say, Thomas.** Acad. Nat. Sci. Phila. Jour. 3:406 (Original description); same in Ent. N. Am. Compl. Wr. 1883. 2:189
1838 **Randall, J. W.** Bost. Jour. Nat. Hist. 2:43-44 (Described as S. trigeminata at Cambridge Mass.)
1852 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. ser. 2, 2:164 (Description, distribution)
1853 **Haldeman, S. S.** Am. Phila. Soc. Trans. n. s. 10:55 (Listed, as Compsidea puncticollis)
1878 **Zimmerman, C. D.** Can. Ent. 10:220 (On poison ivy June 6)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)
1890 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, 1889, p.52 (In grapevines and probably Virginia creeper)
1890 **Smith, J. B.** Cat. Ins. N. J. p.212 (Rare on Rhus radicans)
1895 **Hamilton, John.** Am. Ent. Soc. Trans. 22:370 (Not common on Rhus radicans June)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:81 (In poison ivy, Rhus toxicodendron)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 151 (Systematic account)
1898 **Wickham, H. F.** Can. Ent. 30:41, 42 (Specific characters, food plants)
1899 **Harrington, W. H.** Ent. Soc. Ont. 29th Rep't, 1898, p.89 (In larger living stems of Virginia creeper)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.215 (Attacks poison ivy and oak); same in Ent. Agric. Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Ins. N. J. State Bd Agric. 27th Rep't, sup. p.297 (On Rhus radicans and R. toxicodendron)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed on Rhus)

Saperda populnea Linn.

This European species is found on the Pacific coast, and the examples from different localities now before us can not be distinguished in any particular from European specimens. With this species we include as subspecies the S. moesta of LeConte and a new form that differs from either, under the name tulari.

They differ from populnea as well as from each other in the punctures on the elytra as well as in the punctulations on

the intervals, also in color and vestiture, and while some specimens come very close to each other, we have seen no intergrades of color and vestiture. T u l a r i in character seems to us to be intermediate between m o e s t a and c o n c o l o r.

It may be well at this point to remember that our species have originated in the East, where all are found except two, p o p u l n e a and h o r n i i. Of these, p o p u l n e a has not specialized from the Old World form, as has h o r n i i, which is evidently descended from and is still closely related to s i m i l i s. C a l c a r a t a is the only one of our species that extends to the west coast, where it has been found by Professor Piper in Washington.

Bearing this in mind and remembering that m o e s t a, as a

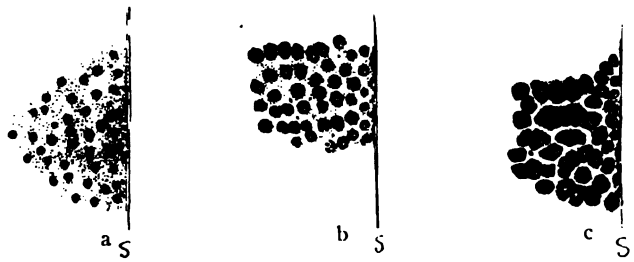


Fig. 7 Elytral characters of females: *a* t u l a r i, punctures scattered; *b* m o e s t a, punctures contiguous; *c* p o p u l n e a, punctures confluent

unicolorous form, as we know it in the East, has not crossed the Sierras and has not yet been found on the coast, there can be no question of its being distinct.

T u l a r i, like m o e s t a, is evidently of American origin and not an emigrant from the Old World. The punctures and dense punctulations in the elytra show a wider divergence from p o p u l n e a than m o e s t a and connect that species and m o e s t a with c o n c o l o r.

Description S. p o p u l n e a Linn. [pl. 7, fig. 4]. Black, shining, coarsely and deeply punctured, the punctures often contiguous and confluent on the elytra; a few punctulations which are sometimes wanting occurring between the punctures; sparsely covered with a light gray or fulvous pubescence; thorax with a lateral band of dense fulvous or yellowish gray hairs; elytra

with eight small spots of dense fulvous or yellowish hair, arranged in pairs, the first and third nearer the suture, the third pair being the largest; one or more pairs often obsolete, the third pair being the most permanent; antennae black, annulated with gray, first joint black.

S. moesta Lec. like populnea; but the vestiture is a uniform light gray without spots, and the lateral line on the thorax only faintly shown.

The punctulations on the intervals between the punctures are more numerous than in populnea.

S. tulari n. subsp. [pl. 7, fig. 6] like populnea and moesta; but the punctures, which are larger and deeper and usually with an edge, are not so numerous as in the other two species and seldom confluent; the intervals are densely punctulate as in concolor. It is densely covered with red or fulvous hair. Thorax with a stripe on side and a median band on top. Types in collection of L. H. Joutel and National Museum, Washington.

The above discriptions apply more particularly to the females.

Distribution. S. populnea, moesta and tulari. With the material before us, it may be well to revise the distribution of these species, which have been confused. As stated, moesta does not occur on the Pacific coast and so must be dropped from the lists of that section.

S. populnea. Well marked examples have been seen from Washington, Oregon, California, Spokane Wash. and Los Angeles county, Cal. In Europe it feeds in poplar and willow stems forming galls.

S. moesta. Canada to Wyoming, Idaho, Montana, Colorado, New York, Wisconsin, Pennsylvania, Buffalo, Montreal, Toronto, Lake Superior. It feeds in balsam poplar. Moesta has never been found in the vicinity of New York city to our knowledge; and the one from Staten Island cited by Smith in *Insects of New Jersey*, was probably concolor.

S. tulari. Tulare county, Cal., Yosemite Cal., Arizona, Nevada, Oregon, Washington.

Saperda moesta Lec.

This insect [pl. 7, fig. 5] confines its operations to the balsam poplar or balm of Gilead so far as known, and occasionally it is quite injurious to this tree.[1]

Life history. The beetles appear in June. Two sizes of larvae in gall-like swellings from 1 to 2 inches apart and in shoots about ½ inch in diameter were found by Mr Harrington in June. The late Dr D. S. Kellicott bred Sciapteron tricincta Harr. from enlargements in the branches and stems of the balm of Gilead and the common willow[2] which were caused by this species and its associate, Saperda concolor. Mr Saunders states that he received a bundle of balm of Gilead twigs on Mar. 25 which were infested with this insect. The larvae were very thickly set in the branches, in many places not more than an inch or two apart, and located chiefly at the base of the buds, where the presence of the occupant was indicated by a swelling in the branch which was surmounted by a dark brown patch of partly decayed bark. The castings and debris of the borer were of a light orange color and were pushed forward, stuffing the swollen part. The whole length of the excavation made by each larva did not usually exceed an inch, and so much of this was filled with debris that the clear space left was very little larger than its body. Mr Saunders describes the larvae as follows:

Body above deep yellow, with a glossy surface, sprinkled with very minute, short yellow hairs, invisible without a lens. Second segment above and below a little deeper in color and more horny looking than the other segments; interspaces between segments strongly indented. There was a depressed dorsal line not different in color from the rest of the body, but sunken, and on each side of it the projecting rings of the body were somewhat flattened. Spiracles pale brown, rather small. Terminal segment a little more hairy than the others.

---

[1] Mr Charles Stevensen, of Montreal, kindly sent us some fresh galls of Saperda moesta, from which the illustrations were made and a number of specimens reared.

[2] Moesta probably caused the galls in balm of Gilead, and concolor those in the willow.

The bunch of twigs received Mar. 25, as above stated, were examined by Mr Saunders May 2, when he found that no pupal inclosure was to be seen, though the head, antennae and legs of the beetle were fully developed, while the wings and wing cases were only partially so. On May 16 the wing cases of one beetle were full length but not fully expanded, while in another case they were fully developed. The twigs containing these insects had been kept in a dry room and hence they were quite dry and brittle. Fresh twigs received May 24 showed that a considerable number of the occupants had been eaten by woodpeckers, though some five or six specimens were found in pupal cells, one of which was occupied by the pupa of a parasite. The pupa of this Saperda has been described by Mr Saunders as follows:

Body semitransparent; color uniform pale yellow, except the eyes and mandibles, which were black; the jaws were faintly tipped with brown and a faint brown line down each side of the scutellum. All the parts of the insect were plainly visible throughout the pupal case. The wings were very small and diverged to each side of the scutellum.

May 29 two of the pupae from the fresh lot of twigs had become perfect beetles, and early in June all had completed their transformations and escaped through neat round holes.

Bibliography[1]

1850 **LeConte, J. L.** Lake Superior, Agassiz and Cabot, p.234 (Original description)
1852 ——— Acad. Nat. Sci. Phila. Jour. 2:163 (Description, distribution)
1873 ——— Class. Coleopt. N. Am. Smithsonian Miscel. Coll. 265, p.346 (Ranges from Canada to Oregon)
1874 **Saunders, William.** Can. Ent. 6:61-63 (Notes on life history, in balm of Gilead)
1877 **Provancher,** *L'abbé* **L.** Faune Can. 1 Coleopt. p.635 (Description)
1880 **Zesch, Frank & Reinecke, Ottomar.** List of Coleoptera of Buffalo and Vicinity, p.10 (Listed)
1881 **Packard, A. S.** U. S. Ent. Com. Bul. 7, p.118 (Boring poplar and balm of Gilead, larva described)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:326 (Distribution, attacks poplars)

[1]This also comprises what was formerly referred to m o e s t a and includes p o p u l n e a and t u l a r i.

1884 **Harrington, W. H.** Can. Ent. 16:102 (On balsam poplar in June, two sizes of larvae)
1890 ——— Ent. Soc. Ont. 20th Rep't, 1889, p.52 (Produces galls in poplar)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.436 (Attacks poplar and balm of Gilead, larva described)
1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:31 (Bibliography of transformations)
1892 **Kellicott, D. S.** Can. Ent. 24:209 (Bred Sciapteron tricincta from enlargements in Populus candicans and willow)
1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (In smaller branches of poplar and willow)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 151 (Systematic account)
1898 **Wickham, H. F.** Can. Ent. 30:42 (Specific characters, food plants)
1899 **Smith, J. B.** Cat. Ins. N. J. State Bd Agric. Rep't, sup. p.297 (Staten Island, in willow)
1900 **Felt, E. P.** State Ent. 15th Rep't. N. Y. State Mus. Bul. 31, 6:556 (Bred from Populus balsamifera May 26)

Saperda concolor Lec.

This species, which requires but one year to complete its transformations, so far as our observations go, girdles the trunks of sapling poplars by running a mine around them, which causes a swelling often nearly twice the size of the diameter of the tree, as described by Dr Packard. It infests dwarf willow canes as stated by Dr Hamilton; and the following is from his account of the insect.

Life history. The beetles appear from the last week in May till after the middle of June. The smaller canes, ¼ to ¾ inch in diameter, of Salix longifolia growing along water courses are usually selected by this insect for breeding places. The beetle gnaws a longitudinal incision through the bark, about ¾ inch in length, and deposits an egg in each end. Several are usually made in the same cane some distance apart and these often cause its death the following year. A warty, gnarly swelling occurs around each incision [pl. 6, fig. 14]. The young larvae [pl. 6, fig. 12, 13] follow the same course as those of S. fayi, only they burrow deeper into the wood, and there are no supernumeraries, as there is no need of them, since the wood of the willow dies much more quickly than that of Crataegus.

The beetle, however, does not always select the smaller canes for oviposition, sometimes choosing those from 1½ to 2 inches in diameter, when the larvae pursue a different course, for, instead of boring up and down, they take a transverse direction and girdle the stem ⅓ to ½ its circumference, causing a rough annular swelling and frequently killing the cane.

The head of the pupa is toward the opening from which the perfect insect emerges. Salix concolor appears to be its natural food, and, did this beetle confine its attention to this shrub, it could hardly be classed as injurious; but in the vicinity of Providence R. I., at least, it has inflicted considerable damage on the common poplar. Two parasites, Pimpla pedalis and a species of Bracon, have been reared from the galls of this insect by Professor Davis.

Description. Black, finely punctulate, and with numerous small, shallow punctures; entirely covered by a dense gray or yellowish gray pubescence except at the top of the thorax, where it is less dense, this giving it a darker appearance and increasing the effect of the lateral band; a slight median line on the thorax; antennae black, annulated with gray. Var. unicolor n. var. [pl. 6, fig. 15]. Like type, but pubescence uniformly dark gray and finer. The punctures are much more numerous than the type and are apt to be confluent. This variety is the eastern form and is named as we believe it to be the ancestral form of the species.[1]

Distribution. This insect has been thus recorded: Sante Fe N. M. [LeConte], Cliftondale Mass. [Henshaw], Buffalo [Zesch-Reinecke], Providence R. I. [Packard], Allegheny Pa., Texas, Michigan, Canada and New York [Hamilton], New Jersey [Smith], Ohio [Kellicott]; rare [Provancher], Canada, Massachusetts, New York, New Jersey, Pennsylvania, Michigan, New Mexico [Leng-Hamilton] Arizona.

[1]This insect is often confused in collections with moesta and Mecas inornata. The type form is from New Mexico, and the same form has been received from Arizona. Var. concolor is from the other localities above and also from Idaho, from which an intermediate form has been received. There is no question of their being forms of one species, the change being due entirely to climatic influences. It is very close to tulari.

Remedies. Dr Lugger advises the use of a soft soap and paris green wash as a preventive of oviposition. He states that the presence of the larvae is also easily discovered by the discolored blotch on the bark and by the little heaps of sawdust that are pushed out by them during their boring operations.

The grubs may be killed by means of a wire or with a pruning knife.

Bibliography

1853 **LeConte, J. L.** Acad. Nat. Sci. Phila. Jour. 2:163 (Original description, from Santa Fe)
1867 **Walsh, B. D.** Ent. Soc. Phila. Proc. 6:264-65 (Describes gall, erroneously referred to Mecas inornata)
1874 **Henshaw, Samuel.** Psyche, 1:23 (At Cliftondale Mass.)
1877 **Provancher,** *L'abbé* **L.** Faune Ent. Can. 1 Coleopt. p.633, 635 (Description, rare)
1880 **Zesch, Frank & Reinecke, Ottomar,** List of Coleoptera of Buffalo and Vicinity, p. 10 (Listed)
1881 **Packard, A. S.** U. S. Ent. Com. Bul. 7, p.118 (Girdles sapling poplars)
1884 **Dimmock, George.** Stand. Nat. Hist. 2:326 (Attacks poplars)
1885 **Hamilton, John.** Can. Ent. 17:36 (In dwarf willow)
1888 ——— Can. Ent. 20:8-9 (Life history and habits, in Salix concolor and poplar)
1888 ——— Ent. Soc. Ont. 18th Rep't, 1887, p.42 (Life history, distribution)
1889 ——— Can. Ent. 21:105 (Habits of larvae and beetles)
1889 **Harrington, W. H.** Ent. Soc. Ont. 20th Rep't, p.52 (In willow)
1889 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 9, November, p.56-57, fig.9 (Life history, habits, remedies)
1889 **Riley, C. V.** Insect Life, 2:164 (Mention)
1890 **Cook, A. J.** Mich. Agric. Exp. Sta. 3d Rep't, p.118 (Described, gives some food plants and the authorities)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.427 (Work in willow after Walsh, erroneously referred to Mecas inornata), p.436 (Work and beetle described, in poplar)
1890 **Smith, J. B.** Cat. Ins. N. J. p.212 (Hudson county)
1891 **Beutenmuller, William.** N. Y. Micro. Soc. Jour. 7:32 (Bibliography of transformations)
1891 **Davis, G. C.** Insect Life, 4:66 (In galls on willow)
1892 ——— Ent. Soc. Ont. 22d Rep't, 1891, p.81 (In galls on Salix discolor)
1892 **Kellicott, D. S.** Can. Ent. 24:209-10 (Bred Sciapteron tricincta from enlargements in stems and branches of poplars and Salix)
1892 ——— Insect Life, 5:82 (Same as preceding)
1895 **Hamilton, John.** List Coleopt. Southwest. Pa. etc. Am. Ent. Soc. Trans. 22:370 (Common in Salix longifolia)

1896 **Beutenmuller, William.** N. Y. Ent. Soc. Jour. 4:80 (In poplars and willows)
1896 **Leng, C. W. & Hamilton, John.** Am. Ent. Soc. Trans. 23:147, 151 (Systematic account)
1898 **Johnston, James.** Can. Ent. 30:71 (Taken at Hamilton Ont. May 1. June on swamp willow)
1898 **Wickham, H. F.** Can. Ent. 30:42 (Specific characters, food plants)
1899 **Lugger, Otto.** Minn. Agric. Exp. Sta. Bul. 66, p.215 (Forms galls in young aspen trunks); same in Ent. Agric. Exp. Sta. 5th Rep't, p.131
1899 **Smith, J. B.** Ins. N. J. State Bd Agric. 27th Rep't, sup. p.297 (Wherever swamp willows occur)
1902 **Dury, Charles.** Cin. Soc. Nat. Hist. Jour. 22:163 (Listed)

EXPLANATION OF PLATES[1]

PLATE 1

Saperda candida

Appletree borer

1 Beetle at rest on the bark
2 Scar indicating the presence of a young grub beneath and also showing a characteristic oviposition slit
3 Sawdust or borings ejected by half or two thirds grown larva. This is usually found very close to the base of the tree.
4 Exit hole of the beetle, in section
5 Borer or grub preparing its pupal chamber
6 Pupal chamber with exit hole of beetle shown at 7
8 Blackened old burrow seen in trees attacked a year or two earlier

PLATE 2

Saperda calcarata

Poplar borer

1 Beetle at rest on the bark
2 Pupa in its chamber, and below it a mass of long fibrous tissues, partly torn from the sides of the burrow
3 Larva or borer in its gallery. This illustration shows the expanded character of the burrow near the orifice through which the larva ejects its numerous borings. The blackened appearance of old galleries is also represented, as well as their occurrence at different depths in the wood.

[1] Executed from nature by the junior author, L. H. Joutel, New York.

PLATE 3

1 Portion of elm bark illustrating the work of the larva of the elm borer, Saperda tridentata. It will be seen that many of the borings are in dead tissues, and that a few extend into the living bark, which apparently gradually dies and permits the insect to extend its operations over a considerable area.

2 Piece of hickory bark illustrating the work of the larva of S. discoidea. The white sawdust excavated from a pupal chamber made in the wood is shown at *a*, and a pupal chamber in the bark is represented at *b*.

3 S. tridentata

4 S. imitans

5 S. discoidea, female

6 S. discoidea, male

PLATE 4

Saperda cretata and **concolor**

Spotted appletree and *willow borers*

1 Work of S. cretata in thorn, showing the irregular character of its galleries, and the different depths at which they occur

2 Adult beetle

3 S. concolor, enlarged

4 Work of this species or possibly S. tulari in Arizona willow. This illustration represents the peculiar gall, the general form of the galleries and pupal cell, with the exit hole in section.

PLATE 5

Saperda vestita and **obliqua**

Linden and *alder borers*

1 Portion of the base of a linden, showing the work of the larva of S. vestita, and at *a* the circular exit hole of the adult

2 A small alder stem, showing the enlargement produced by the larva of S. obliqua a year after the stem had been deserted

3 An alder stem showing the external appearance, indicating recent operations of the larva of S. obliqua and at *b* the pupal cell with the mass of borings blocking one end

4 Section of alder stem showing the method of work of the larva of S. obliqua
5 S. vestita, female
6 S. obliqua

PLATE 6

Saperda fayi

Thorn borer

A Branch of the thorntree showing the galls and work of this species
1 An old gall with a larger one just below it
2 Section of a fresh gall showing the work of the larva
2a Borings in the stem
3 Exit hole of the beetle in section
4 Adult, enlarged

Saperda puncticollis

Virginia creeper borer

B Portion of Virginia creeper, representing the galls and work of this species
5 Section of the stem, showing the pupal chamber
6 Larva at work under the bark
7 Exit hole in section
7a Exit hole
8 Section of thin bark and sawdust stopper closing opening to pupal chamber
8a Same shown in a surface view
9 Beetle, enlarged

Saperda concolor var. **unicolor**

Willow borer

C Branch of poplar, showing the galls and work of this insect
11 Fresh galls and exit holes of beetles
12 Fresh gall cut open and showing the pupal cells: one empty, one occupied, and one extending up and the other down
13 Section of old gall showing the internal appearance of the tissues
14 External appearance of old galls
15 Beetle, enlarged

PLATE 7

1 Saperda calcarata var. adspersa
2 S. mutica
3 S. hornii
4 S. populnea, enlarged
5 S. moesta. The long line at its side shows the average length of Idaho specimens, the short one, that of New York, Canadian, and west of Wisconsin to Michigan specimens.
6 S. tulari, enlarged
7 Galls of S. moesta
   A Young gall shows wound caused by female
   B Exit hole
8 S. lateralis, enlarged
9 S. lateralis var. connecta, enlarged
10 Galls of S. moesta, with one cut open showing the pupal chamber
   A Oviposition scar
   B Exit hole of the beetle

PLATE 8

Early work of **Saperda candida**

Appletree borer

1 Oviposition scars made by the female
2 Borings or frass thrown out by young grubs working under the bark
3 Bark cut away, showing the young larva in its gallery and its method of work
4 Scar showing old, overgrown exit hole
5 Upper portion of the wound caused by the insect, which emerged several years before at 4

The number of grubs in this small stem, which is only about 1¼ inches in diameter, is sufficient to kill a tree.

PLATE 9

Advanced work of **Saperda candida**

Appletree borer

This represents the appearance in section and lower portion of a very badly infested stem of a young tree, and shows

that it may be practically riddled before death ensues. The exit holes seen in the upper portion are by no means unusually abundant and such severe injury is certain to result in the death of the tree.

PLATE 10

Advanced work of **Saperda candida**

Appletree borer

1 Base of two year old tree killed by borers

2 Young tree entirely girdled by two borers, showing two exit holes, and at *A* the only connection with the root

3 Young tree killed by borers: *AA* shows the only connection with the root and *B* is a bare area which the tree has tried to cover with living tissue.

PLATE 11

Early work of **Saperda calcarata**

Poplar borer

1 This represents the early galleries and illustrates how a few larvae can easily girdle a young tree, because of their running a portion of their burrows transversely in the inner bark and outer sapwood.

2 Advanced work of S. tridentata, elm borer

PLATE 12

Advanced work of **Saperda calcarata**

Poplar borer

This illustration shows the irregular character of the galleries, the closed pupal cells with the coarse fibers stopping the free end, and the expanded character of the burrows about the exit.

PLATE 13

Saperda fayi

1 Gall in thorn branch, also holes made by woodpeckers searching for grubs

2 Typical, fully developed gall

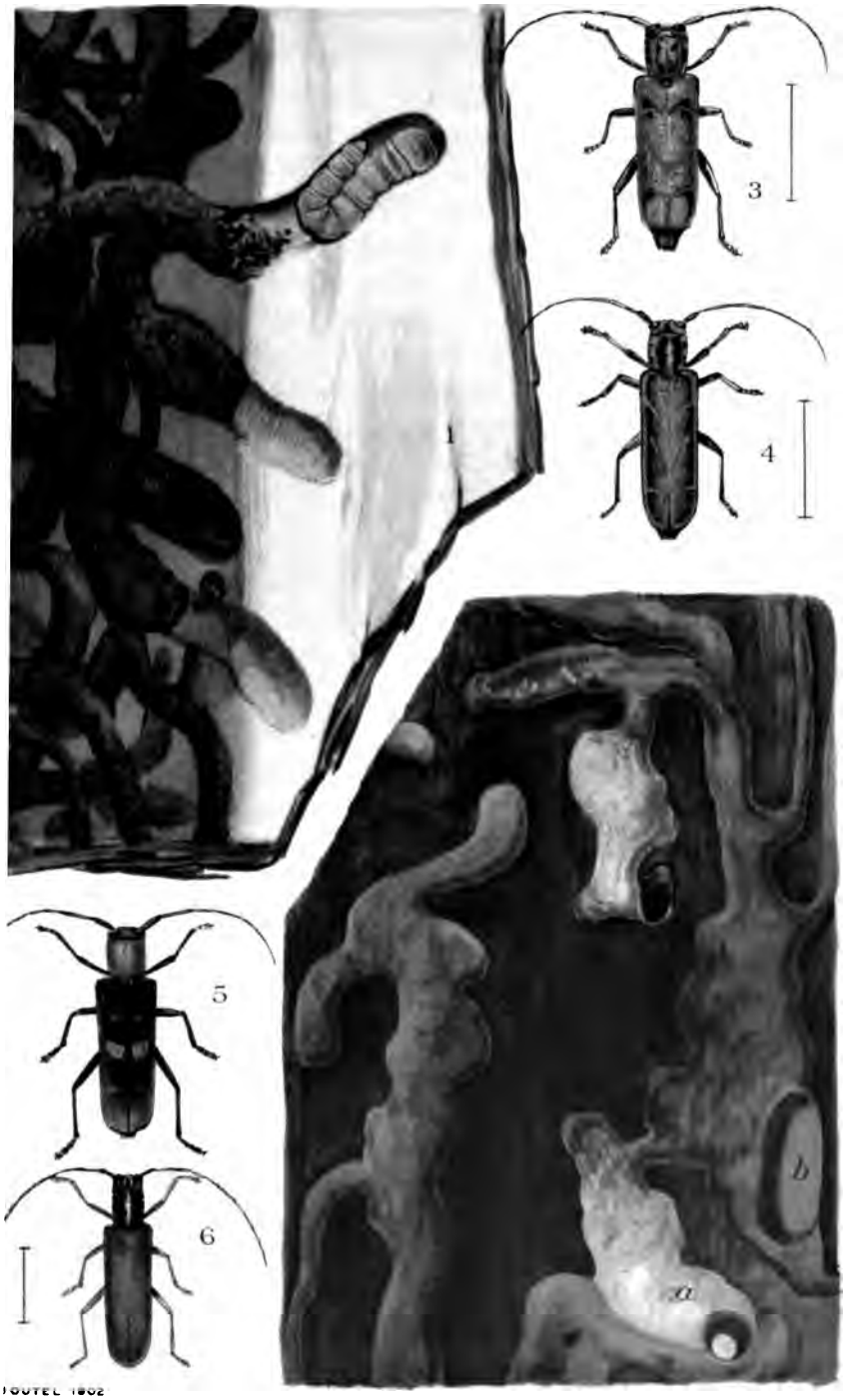
PLATE 14

Holes of woodpeckers in alder, made in search of the larvae of Saperda obliqua

E.H. SOUTH, 1907

Saperda candida, appletree borer

Saperda calcarata, poplar borer



Saperda tridentata, imitans and discoidea
Elm and hickory borers

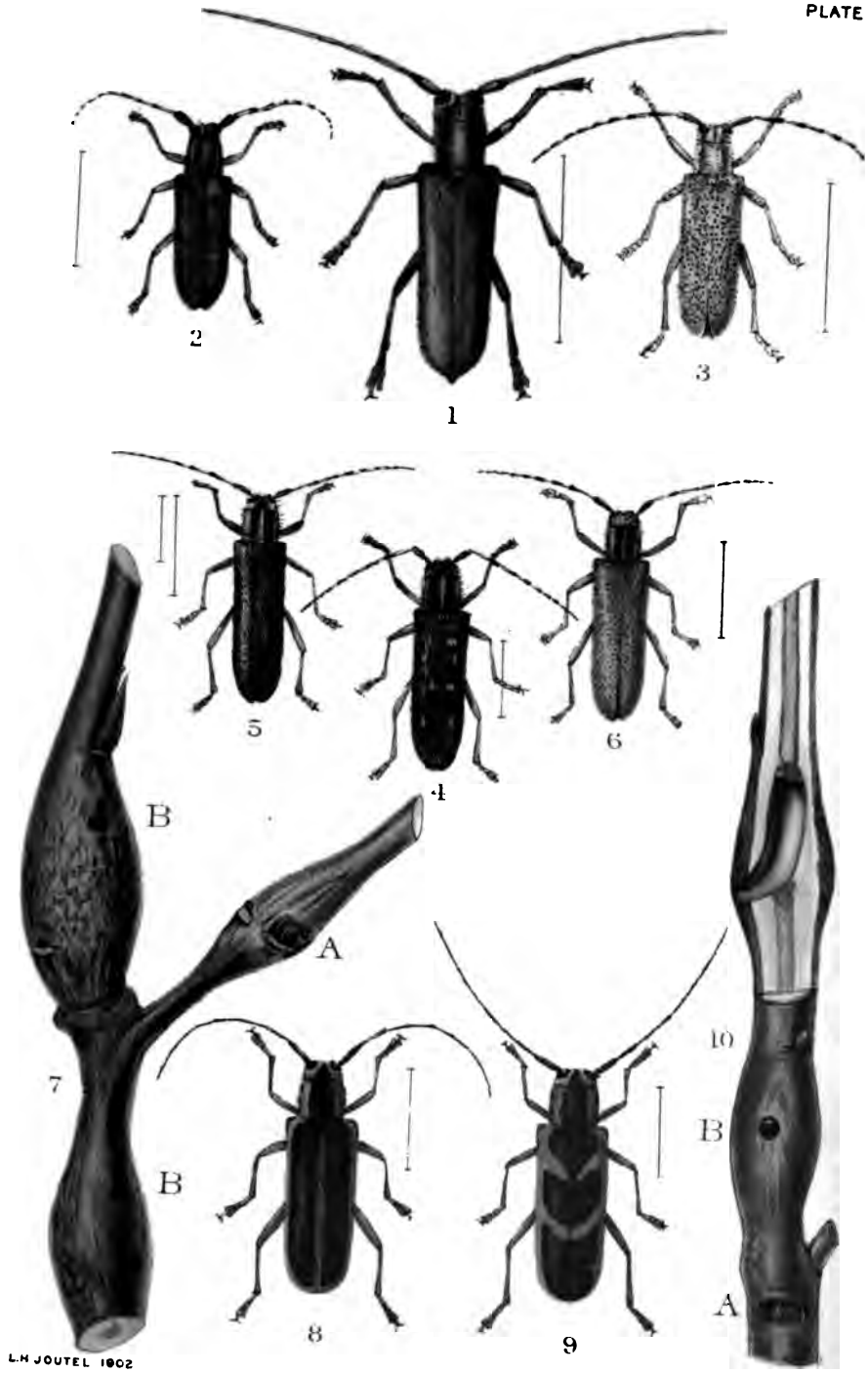
Saperda cretata and concolor
Spotted appletree and willow borers

L.H JOUTEL 1902

Saperda vestita and obliqua
Linden and alder borers

JOUTEL 1962

Saperda fayi, puncticollis and concolor
Thorn, virginia creeper and willow borers



Saperdas

Plate 8

Early work of Saperda candida, appletree borer

Plate 9

Advanced work of Saperda candida, appletree borer

1

2

3

Advanced work of Saperda candida, appletree borer, at base of young trees

1

2

1 Early work of Saperda calcarata, popular borer; 2 Advanced work of Saperda tridentata, elm borer

1

2

1 Early work of Saperda calcarata, popular borer; 2 Advanced work of Saperda tridentata, elm borer

Plate 12

dvanced work of Saperda calcarata, poplar borer

Plate 13

1 2

Woodpecker work and galls of Saperda fayi, in thorn

Plate 14

Woodpecker work in alder stem bored by Saperda obliqua

INDEX

Page numbers referring to descriptions of species are printed in black face type.

Acknowledgments, 3.
Adams, M. F., cited, 41, 45, 47.
Alder species injuring:
  Saperda lateralis, 60.
    obliqua, 17, 18.
Alder borer, 18-20; bibliography, 20; description, 19-20; distribution, 19; natural enemies, 20; life history and habits, 18-19; explanation of plates, 77-78.
Antennal characters, grouping on, 8.
Appletree, species injuring: 4.
  Saperda candida, 17, 23, 28.
    cretata, 17, 50.
Appletree borer round-headed, 23-39; bibliography 31-39; description, 28; natural enemies, 28; food plants, 28; habitat, 27-28; early history, 23-24; life history, 24-27; explanation of plates, 76, 79-80; preventive and remedial measures, 28-31.
Appletree borer, spotted, 50-52; bibliography, 51-52; description, 50; distribution, 50; food plants, 50; life history, 51; explanation of plate, 77; remedies, 51.
armicollis, Magdalis, 44, 45.
Aspen, Saperda calcarata injuring, 41.
Atkins, C. G., cited, 36.

Balm of Gilead, species injuring:
  Saperda concolor, 71.
    moesta, 18, 71.
Balsam poplar, Saperda moesta injuring, 70, 71.
barbita, Magdalis, 44, 45.
Bartlett, J. N., cited, 34.
Bateman, cited, 35.
Bates, cited, 6, 12.
Beach, S. A., cited, 39.
Beadle, cited, 33.
Beaulieu, Germain, acknowledgments to, 4.
Bell, J. T., cited, 34.
Bessey, C. E., cited, 34.
Bethune, C. J. S., acknowledgments to, 4; cited, 27, 33-34, 35, 36.
Beutenmuller, William, cited, 20, 28, 37, 38, 43, 49, 54, 57, 58, 62, 66, 68, 73, 75, 76.
Birch, Saperda obliqua injuring, 19.
Blanchard, Frederick, acknowledgments to, 4; mentioned, 47; cited, 50, 59.
Bland, J. H. B., cited, 66.
Bogue, E. E., cited, 38.
Bolles, Prof., cited, 42; mentioned, 47.
Bowditch, F. C., acknowledgments to, 4.
Brackett, G. E., cited, 33, 35.
Bracon *sp.*, 74.
  charus, 56.
  pectinator, 56.
Briggs, Nathan, cited, 32.
Bruner, Lawrence, cited, 38, 39, 40, 43.
Buckminster, cited, 26, 31.
Buel, Jesse, cited, 31.

calcarata, Saperda, *see* Saperda calcarata.
candida, Saperda, *see* Saperda candida.
carcharias, Saperda, *see* Saperda carcharias.
carinata, Saperda, 6.
Castle, D. M., acknowledgments to, 4.
Caulfield, F. B., cited, 48, 58, 61, 62.
Cenocoelius populator, 28.
Chambers, Prof., cited, 26.
Chambliss, C. E., cited, 37.
charus, Bracon, 56.
Cherry, Saperda candida injuring, 28.
Chittenden, F. H., cited, 38, 50, 52.

Chokeberry, Saperda candida injuring, 28.
Chrysobothris femorata, 23.
Clay, C. M., cited, 35.
Comstock, J. H., cited, 38.
concolor, Saperda, *see* Saperda concolor.
Cook, A. J., cited, 27, 29, 34, 36, 37, 50, 51, 52, 75.
Cooke, Matthew, cited, 36.
Cottonwood, Saperda calcarata injuring, 41.
Couper, William, cited, 23, 32.
Crab apples, Saperda cretata injuring, 50.
Crataegus coccinia, 31.
  crus-galli, 31, 62.
  tomentosa, 62.
cretata, Saperda, *see* Saperda cretata.

Davis, G. C., cited, 38, 75; mentioned, 74.
Davis, William T., acknowledgments to, 4; mentioned, 4.
decem-punctata, Eutatrapha, 8.
Dimmock, George, cited, 9, 26, 34, 36, 43, 48, 57, 62, 72, 75.
discoidea, Saperda, *see* Saperda discoidea.
Distribution of species, 9-10.
Doll, J., cited, 42.
Dury, Charles, cited, 40, 43, 44, 50, 54, 58, 62, 68, 76.
Dyar, H. G., acknowledgments to, 4.

Ehrmann, G. A., cited, 58.
Elaphidion villosum, 60.
Elm, species injuring: 4.
  Saperda lateralis, 59.
    tridentata, 17, 44.
    vestita, 56.
Elm borer, 44-50; description, 46; distribution, 47; food plants, 46; early history, 44-45; life history, 45-46; explanation of plates, 77, 80; remedies, 47; signs of attack, 45.
Emmons, Ebenezer, cited, 9, 32, 41, 42, 48, 57.
Eutatrapha, 6, 7, 12.
  (Saperda) metallescens, 6.
    6-punctata, 6.
  10-punctata, 8.
  (Saperda varicornis, 6, 8.
Exotic species, genera and subgenera, 5.
Explanation of plates, 76-80.

Fabricius, J. C., cited, 9, 21, 31, 54, 61.
Fall, H. C., acknowledgments to, 4.
Faville, E. E., cited, 38.
fayi, Saperda, *see* Saperda fayi.
Felt, E. P., cited, 39, 43-44, 49-50, 73.
femorata, Chrysobothris, 23.
Fernald, C. H., cited, 34.
Fernald, H. T., cited, 39.
Fitch, Asa, cited, 23, 24, 26, 28, 29, 30, 31, 32, 42, 46, 48, 54, 60, 62.
Fletcher, James, cited, 38.
Food habits of larvae, grouping and summary of, 17-18.
Forbes, S. A., cited, 44, 48.
fortunei, Paraglenea, 6, 7.
Fowler, Sam P., cited, 29, 32.
Fuchs, Charles, acknowledgments to, 4.
Fuller, A. S., cited, 35.
Fyles, Thomas W., cited, 38, 39.

Garman, H., cited, 44, 49.
Gay, cited, 26.
Gaylord, W., cited, 31.
Gillette, C. P., cited, 37.
Glenida suffusa, 6.
Grape, Saperda puncticollis injuring, 67.

Haldeman, S. S., cited, 20, 21, 32, 42, 48, 54, 57, 61, 68.
Hamilton, John, cited, 9, 19, 20, 21, 38, 41, 43, 49, 50, 52, 53, 54, 56, 58, 61, 62, 64, 65, 66, 67, 68, 73, 74, 75, 76.
Harrington, W. H., cited, 21, 36, 37, 43, 48, 52, 53, 54, 56, 57, 61, 62, 66, 67, 68, 71, 73, 75.
Harris, E. D., acknowledgments to, 4.

Harris, T. W., cited, 23, 28, 31, 32, 40, 42, 44, 48, 54, 56, 57.
Harvey, F. L., cited, 37, 39.
Haywood, Roland, mentioned, 59.
Hazel shoots, Saperda obliqua injuring, 19.
Heartt, Philip, mentioned, 23, 31.
Henshaw, Samuel, acknowledgments to, 3; species listed by, 5; cited, 61, 62, 74, 75.
Hickory, species injuring: 4.
Saperda discoidea, 18, 52.
imitans, 18, 58.
lateralis, 18, 59.
Hickory Saperda, 52-54; bibliography, 54; description, 53; distribution, 53, 54; natural enemies, 54; food plants, 53; life history, 52-53.
Hoffmeister, A. W., cited, 34.
Horn, G. H., cited, 7, 9, 53.
hornii, Saperda, *see* Saperda hornii.
Howard, L. O., cited, 28, 37, 56, 57.
Hoy, P. R., cited, 35.
Hubbard, H. G., cited, 48.

imitans, Saperda, *see* Saperda imitans.
inornata, Mecas, 74.

Jack, J. G., cited, 38, 41, 43.
Johnson, W. G., cited, 38.
Johnston, James, cited, 38, 76.
Joutel, L. H., cited, 21, 23, 42, 44.
June berry, Saperda cretata injuring, 50.
Junkins, W., cited, 25-26, 36.

Kellicott, D. S., cited, 71, 73, 74, 75.
Kemp, S. T., cited, 60, 62.
Key to species, 15-16.
Klages, H. G., acknowledgments to, 4.
Knab, Fred, cited, 19, 20.
Knaus, W., acknowledgments to, 4.
Kunze, R. E., acknowledgments to, 4.

Lacordaire, cited, 7.
Larvae, grouping and summary of food habits, 17-18.
lateralis, Saperda, *see* Saperda lateralis.
laticollis, Prionus, 40.
Laurent, Philip, acknowledgments to, 4.
Le Baron, William, cited, 9, 34.
Le Conte, J. L., cited, 7, 9, 19, 20, 21, 27, 32, 34, 42, 43, 48, 51, 53, 54, 56, 57, 61, 67, 68, 72, 74, 75.
Leng, Charles W., acknowledgments to, 4; cited, 9, 19, 20, 21, 38, 41, 43, 49, 50, 52, 54, 56, 58, 61, 62, 65, 66, 67, 68, 73, 74, 76.
Linden, species injuring: 4.
Saperda vestita, 18, 54.
Linden borer, 54-58; bibliography, 57-58; description, 56; distribution, 56; natural enemies, 56; food plants, 56; early history, 54-55; life history, 55-56; explanation of plate, 77-78; remedies, 56-57.
Lintner, J. A., cited, 36, 37, 38, 43, 44, 49, 52, 57, 58, 63.
Lowe, V. H., cited, 39.
Lugger, Otto, cited, 19, 20, 39, 41, 43, 49, 52, 54, 58, 67, 68, 75, 76.

McCarthy, G., cited, 37.
McMillan, Conway, cited, 26, 27, 37.
Magdalis armicollis, 44, 45.
barbita, 44, 45.
Marshall, W. S., acknowledgments to, 4.
Mecas inornata, 74.
metallescens, Saperda, 6, 12.
moesta, Saperda, *see* Saperda moesta.
Moffat, J. A., cited, 53, 54, 63, 65, 66.
Morris, M. H., cited, 32.
Mountain ash, Saperda candida injuring, 28.
Mulsant, cited, 5.
Munson, W. M., cited, 39.
mutica, Saperda, *see* Saperda mutica.

Newman, Edward, cited, 51.

Oak, Saperda puncticollis injuring, 67.
obliqua, Saperda, *see* Saperda obliqua.
octo-punctata, Saperda, 7.

Subgeneric grouping, 7.
suffusa, Glenida, 6.

Templin, L. J., cited, 50.
Thomas, Cyrus, cited, 9, 24, 35, 48.
Thomson, J., cited, 6.
Thorn, species injuring:
  Saperda candida, 28.
    cretata, 17.
    fayi, 18, 62.
Thorn limb borer, 62-66; bibliography, 66; description, 65; distribution, 65; natural enemies, 66; life history, 63-65; explanation of plate, 78, 79.
Thyestes, 6, 7.
  pubescens, 8.
Tolman, Adams, cited, 24, 37, 60, 61, 62.
Townsend, [C. H.] Tyler, 37.
Tracy, William W., cited, 34.
Treat, Mary, cited, 24, 28, 38.
tricincta, Sciapteron, 71.
tridentata, Saperda, *see* Saperda tridentata.
trigeminata, Saperda, 68.
tulari, Saperda, *see* Saperda tulari.

Uhler, P. R., cited, 32.

Van Dyke, Henry C., acknowledgments to, 4; cited, 17; mentioned, 23.
varicornis, Eutatrapha (Saperda), 6, 8.
varicornis, Saperda, 12.
vestita, Saperda, *see* Saperda vestita.
villosum, Elaphidion, 60.
Virginia creeper, Saperda puncticollis injuring, 18, 67, 68, 78.

Walsh, B. D., cited, 28, 32, 33, 41, 42, 62, 75.
Watson, F. E., acknowledgments to, 4.
Webster, F. M., acknowledgments to, 4; cited, 18, 39, 56, 58.
Weed, C. M., cited, 29, 37.
Weed, H. E., cited, 38.
Wenzel, H. W., acknowledgments to, 3; cited, 21, 50.
Wickham, H. F., cited, 9, 20, 21, 38, 43, 52, 54, 58, 62, 66, 68, 73, 76.
Wielandy, J. F., cited, 33.
Wier, D. B., cited, 23, 24, 26, 34.
Willow, species injuring:
  Saperda calcarata, 41.
    concolor, 18, 71, 73.
    hornii, 17, 23.
    moesta, 71.
    mutica, 17, 21.
    populnea, 18.
    tulari, 18.
Willow borer, explanation of plates, 77, 78.
Winne, A. F., acknowledgments to, 4.
Woodbine borer, 66-68; bibliography, 68; description, 67; distribution, 67-68; food plants, 67.
Woodward, C. W., acknowledgments to, 4.

Young, D. B., cited, 55.

Zabriskie, J. L., cited, 56, 58.
Zesch, Frank, cited, 19, 20, 21, 35, 43, 48, 53, 54, 56, 57, 61, 62, 66, 68, 72, 74, 75.
Zimmerman, C. D., cited, 24, 35, 63, 65, 66, 67, 68.

University of the State of New York

New York State Museum

PUBLICATIONS

Postage or express to places outside of New York State must be paid in addition to the price given. On 10 or more copies of any one publication 20% discount will be given, the buyer to pay transportation. Editions printed are only large enough to meet special claims and probable sales. When the sale copies are exhausted, the price for the few reserve copies is advanced to that charged by secondhand booksellers, in order to limit their distribution to cases of special need. Such prices are inclosed in [ ]. All publications are in paper covers, unless binding is specified.

Museum annual reports 1847-date. *All in print to 1892, 50c a volume, 75c in cloth; 1892-date, 75c, cloth.*

These reports are made up of the reports of the director, geologist, paleontologist, botanist and entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Geologist's annual reports 1881-date. Rep'ts 1, 3-13, 17-date, O; 2, 14-16, Q.

The annual reports of the early natural history survey, 1837-41 are out of print.

Reports 1-4, 1881-84 were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	*Price*	*Report*	*Price*	*Report*	*Price*
12 (1892)	$.50	16	$1	19	$.40
14	.75	17	.75	20	.50
15, 2v.	2	18	.75	21	.40
				22	.40

In 1898 the paleontologic work of the State was made distinct from the geologic and will hereafter be reported separately.

Paleontologist's annual reports 1899-date.

See fourth note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Since 1901 these reports have been issued as bulletins.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882-date.

Reports 3-17 bound also with museum reports 40-46, 48-55 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3-4 are out of print, other reports with prices are:

Report	*Price*	*Report*	*Price*	*Report*	*Price*
1	$.50	9	$.25	14 (Ent. 5)	$.20
2	.50	10	.35	15 (" 9)	.15
5	.25	11	.25	16 (" 10)	.25
6	.15	12	.25	17 (" 14)	.30
7	.20	13	.10	18 (" 17)	.20
8	.25			19 *In press*	

Reports 2, 8-12 may also be obtained bound separately in cloth at 25c in addition to the price given above.

Botanist's annual reports 1867-date.

Bound also with museum reports 21-date of which they form a part; the first botanist's report appeared in the 21st museum report and is numbered 21. Reports 21-24, 29, 31-41 were not published separately.

Separate reports 25-28, 30, 42-50 and 52 (Botany bulletin 3), are out of print. Report 51 may be had for 40c; 53 for 20c; 54 for 50c. Since the 55th these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have been published in volumes 1 and 3 of the 48th museum report and in volume 1 of the 49th, 51st, 52d, 54th and 55th reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum memoir 4.

Museum bulletins 1887-date. O. *To advance subscribers, $2 a year or 50c a year for those of any one division:* (1) *geology, economic geology, mineralogy, general zoology, archeology and miscellaneous,* (2) *paleontology,* (3) *botany,* (4) *entomology.*

Bulletins are also found with the annual reports of the museum as follows:

Bulletin	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*
12–15	48, v. 1	20–25	52, v. 1	35-36	54, v. 2
16–17	50 "	26–31	53 "	37-44	" v. 3
18–19	51 "	32–34	54 "	45-48	" v. 4
				49-54	55, v. 1

The figures in parenthesis indicate the bulletin's number as a New York State Museum bulletin.

Geology. G1 (14) Kemp, J. F. Geology of Moriah and Westport Townships, Essex Co. N. Y., with notes on the iron mines. 38p. 7pl. 2 maps. Sep. 1895. *10c.*

G2 (19) Merrill, F: J. H. Guide to the Study of the Geological Collections of the New York State Museum. 162p. 119pl. map. Nov. 1898. [*50c*] *New edition in preparation.*

G3 (21) Kemp, J. F. Geology of the Lake Placid Region. 24p. 1pl. map. Sep. 1898. *5c.*

G4 (48) Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. 58p. il. 9pl. map. Dec. 1901. *25c.*

G5 (56) Merrill, F: J. H. Description of the State Geologic Map of 1901. 42p. 2 maps, tab. Oct. 1902. *10c.*

G6 Cushing, H. P. Geology of the Vicinity of Little Falls, Herkimer Co. *In press.*

——— Crystalline Rocks of the Northeastern Adirondacks. *In press.*

Kemp, J. F. Crystalline Rocks of Warren and Washington Counties. *In preparation.*

Woodworth, J. B. Glacial Geology of New York. *In preparation.*

Economic geology. Eg1 (3) Smock, J: C. Building Stone in the State of New York. 152p. Mar. 1888. *Out of print.*

Eg2 (7) —— First Report on the Iron Mines and Iron Ore Districts in the State of New York. 6+70p. map. June 1889. *Out of print.*

Eg3 (10) —— Building Stone in New York. 210p. map, tab. Sep. 1890. *40c.*

Eg4 (11) Merrill, F: J. H. Salt and Gypsum Industries of New York. 92p. 12pl. 2 maps, 11 tab. Ap. 1893. *40c.*

Eg5 (12) Ries, Heinrich. Clay Industries of New York. 174p. 2pl. map. Mar. 1895. *30c.*

Eg6 (15) Merrill, F: J. H. Mineral Resources of New York. 224p. 2 maps. Sep. 1895. *50c.*

Eg7 (17) —— Road Materials and Road Building in New York. 52p. 14pl. 2 maps 34x45, 68x92 cm. Oct. 1897. *15c.*
Maps separate *10c each, two for 15c.*

Eg8 (30) Orton, Edward. Petroleum and Natural Gas in New York. 136p. il. 3 maps. Nov. 1899. *15c.*

Eg9 (35) Ries, Heinrich. Clays of New York; their Properties and Uses. 456p. 140pl. map. June 1900. *$1, cloth.*

Eg10 (44) —— Lime and Cement Industries of New York; Eckel, E. C. Chapters on the Cement Industry. 332p. 101pl. 2 maps. Dec. 1901. *85c, cloth.*

Eg11 (61) Dickinson, H. T. Quarries of Bluestone and other Sandstones in New York. 108p. 18pl. 2 maps. Mar. 1903. *35c.*

Mineralogy. M1 (4) Nason, F. L. Some New York Minerals and their Localities. 20p. 1pl. Aug. 1888. [*10c*]

M2 (58) Whitlock, H. P. Guide to the Mineralogic Collections of the New York State Museum. 150p. il. 39pl. 11 models. Sep. 1902. *40c.*

M3 (70) —— New York Mineral Localities. 110p. Sep. 1903. *20c.*

Paleontology. Pa1 (34) Cumings, E. R. Lower Silurian System of Eastern Montgomery County; Prosser, C: S. Notes on the Stratigraphy of Mohawk Valley and Saratoga County, N. Y. 74p. 10pl. map. May 1900. *15c.*

Pa2 (39) Clarke, J: M.; Simpson, G: B. & Loomis, F: B. Paleontologic Papers 1. 72p. il. 16pl. Oct. 1900. *15c.*

Contents: Clarke, J: M. A Remarkable Occurrence of Orthoceras in the Oneonta Beds of the Chenango Valley, N. Y.
——Paropsonema cryptophya; a Peculiar Echinoderm from the Intumescens-zone (Portage Beds) of Western New York.
——Dictyonine Hexactinellid Sponges from the Upper Devonic of New York.
——The Water Biscuit of Squaw Island, Canandaigua Lake, N. Y.
Simpson, G: B. Preliminary Descriptions of New Genera of Paleozoic Rugose Corals.
Loomis, F: B. Siluric Fungi from Western New York.

Pa3 (42) Ruedemann, Rudolf. Hudson River Beds near Albany and their Taxonomic Equivalents. 114p. 2pl. map. Ap. 1901. *25c.*

Pa4 (45) Grabau, A. W. Geology and Paleontology of Niagara Falls and *Vicinity.* 286p. il. 18pl. map. Ap. 1901. 65c; cloth 90c.

Pa5 (49) Ruedemann, Rudolf; Clarke, J: M. & Wood, Elvira. Paleontologic Papers 2. 240p. 13pl. Dec. 1901. *40c.*

Contents: Ruedemann, Rudolf. Trenton Conglomerate of Rysedorph Hill.
Clarke, J: M. Limestones of Central and Western New York Interbedded with Bituminous Shales of the Marcellus Stage.
Wood, Elvira. Marcellus Limestones of Lancaster, Erie Co. N. Y.
Clarke, J: M. New Agelacrinites.
——Value of Amnigenia as an Indicator of Fresh-water Deposits during the Devonic of New York, Ireland and the Rhineland.

Pa6 (52) Clarke, J: M. Report of the State Paleontologist 1901. 280p. il. 9pl. map, 1 tab. July 1902. *40c.*

Pa7 (63) —— Stratigraphy of Canandaigua and Naples Quadrangles. 2 maps. *In press.*

Pa8 (65) —— Catalogue of Type Specimens of Paleozoic Fossils in the New York State Museum. 848p. May 1903. *$1.20, cloth.*

Pa9 (69) —— Report of the State Paleontologist 1902. 464p. 52pl. 8 maps. Nov. 1903. *$1, cloth.*

Pa10 —— Report of the State Paleontologist 1903. *In press.*

Zoology. Z1 (1) Marshall, W: B. Preliminary List of New York Unionidae. 20p. Mar. 1892. *5c.*

Z2 (9) —— Beaks of Unionidae Inhabiting the Vicinity of Albany, N. Y. 24p. 1pl. Aug. 1890. *10c.*

Z3 (29) Miller, G. S. jr. Preliminary List of New York Mammals. 124p. Oct. 1899. *15c.*

Z4 (33) Farr, M. S. Check List of New York Birds. 224p. Ap. 1900. *25c.*

Z5 (38) Miller, G. S. jr. Key to the Land Mammals of Northeastern North America. 106p. Oct. 1900. *15c.*

Z6 (40) Simpson, G: B. Anatomy and Physiology of Polygyra albolabris and Limax maximus and Embryology of Limax maximus. 82p. 28pl. Oct. 1901. *25c.*

Z7 (43) Kellogg, J. L. Clam and Scallop Industries of New York. 36p. 2pl. map. Ap. 1901. *10c.*

Z8 (51) Eckel, E. C. & Paulmier, F. C. Catalogue of Reptiles and Batrachians of New York. 64p. il. 1pl. Ap. 1902. *15c.*

Eckel, E. C. Serpents of Northeastern United States.
Paulmier, F. C. Lizards, Tortoises and Batrachians of New York.

Z9 (60) Bean, T. H. Catalogue of the Fishes of New York. 784p. Feb. 1903. *$1, cloth.*

Z10 (71) Kellogg, J. L. Feeding Habits and Growth of Venus mercenaria. 30p. 4pl. Sep. 1903. *10c.*

Farr, M. S. Birds of New York. *In preparation.*

Letson, Elizabeth J. Catalogue of New York Mollusca. *In preparation.*

Entomology. En1 (5) Lintner, J. A. White Grub of the May Beetle. 32p. il. Nov. 1888. *10c.*

En2 (6) —— Cut-worms. 36p. il. Nov. 1888. *10c.*

En3 (13) —— San José Scale and Some Destructive Insects of New York State. 54p. 7pl. Ap. 1895. *15c.*

En4 (20) Felt, E. P. Elm-leaf Beetle in New York State. 46p. il. 5pl. June 1898. *5c.*

See En15.

En5 (23) —— 14th Report of the State Entomologist 1898. 150p. il. 9pl. Dec. 1898. *20c.*

En6 (24) —— Memorial of the Life and Entomologic work of J. A. Lintner Ph.D. State Entomologist 1874-98; Index to Entomologist's Reports 1-13. 316p. 1pl. Oct. 1899. *35c.*

Supplement to 14th report of the state entomologist.

En7 (26) —— Collection, Preservation and Distribution of New York Insects. 36p. il. Ap. 1899. *5c.*

En8 (27) —— Shade Tree Pests in New York State. 26p. il. 5pl. May 1899. *5c.*

En9 (31) —— 15th Report of the State Entomologist 1899. 128p. June 1900. *15c.*

En10 (36) —— 16th Report of the State Entomologist 1900. 118p. 16pl. Mar. *1901. 25c.*

En11 (37) —— Catalogue of Some of the More Important Injurious and Beneficial Insects of New York State. 54p. il. Sep. 1900. *10c.*

En12 (46) —— Scale Insects of Importance and a List of the Species in New York State. 94p. il. 15pl. June 1901. *25c.*

En13 (47) Needham, J. G. & Betten, Cornelius. Aquatic Insects in the Adirondacks. 234p. il. 36pl. Sep. 1901. *45c.*

En14 (53) Felt, E. P. 17th Report of the State Entomologist 1901. 232p. il. 6pl. Aug. 1902. *30c.*

En15 (57) —— Elm Leaf Beetle in New York State. 46p. il. 8pl. Aug. 1902. *15c.*

This is a revision of En4 containing the more essential facts observed since that was prepared.

En16 (59) —— Grapevine Root Worm. 40p. 6pl. Dec. 1902. *15c.*

See En19.

En17 (64) —— 18th Report of the State Entomologist 1902. 110p. 6pl. May 1903. *20c.*

En18 (68) Needham, J. G. *& others.* Aquatic Insects in New York. 322p. 52pl. Aug. 1903. *80c, cloth.*

En19 (72) Felt, E. P. Grapevine Root Worm. 58p. 13pl. Nov. 1903. *20c.*

This is a revision of En16 containing the more essential facts observed since that was prepared.

En20 (74) Felt, E. P. & Joutel, L. H. Monograph of the Genus Saperda. 88p. 14pl. June 1904. *25c.*

Felt, E. P. 19th Report of the State Entomologist 1903. *In press.*

—— Mosquitos or Culicidae of New York. *In press.*

Botany. Bo1 (2) Peck, C: H. Contributions to the Botany of the State of New York. 66p. 2pl. May 1887. *Out of print.*

Bo2 (8) —— Boleti of the United States. 96p. Sep. 1889. [*50c*]

Bo3 (25) —— Report of the State Botanist 1898. 76p. 5pl. Oct. 1899. *Out of print.*

Bo4 (28) —— Plants of North Elba. 206p. map. June 1899. *20c.*

Bo5 (54) —— Report of the State Botanist 1901. 58p. 7pl. Nov. 1902. *40c.*

Bo6 (67) —— Report of the State Botanist 1902. 196p. 5pl. May 1903. *50c.*

Bo7 —— Report of the State Botanist 1903. *In press.*

Archeology. Ar1 (16) Beauchamp, W: M. Aboriginal Chipped Stone Implements of New York. 86p. 23pl. Oct. 1897. *25c.*

Ar2 (18) —— Polished Stone Articles used by the New York Aborigines. 104p. 35pl. Nov. 1897. *25c.*

Ar3 (22) —— Earthenware of the New York Aborigines. 78p. 33pl. Oct. 1898. *25c.*

Ar4 (32) —— Aboriginal Occupation of New York. 190p. 16pl. 2 maps. Mar. 1900. *30c.*

Ar5 (41) —— Wampum and Shell Articles used by New York Indians. 166p. 28pl. Mar. 1901. *30c.*

Ar6 (50) —— Horn and Bone Implements of the New York Indians. 112p. 43pl. Mar. 1902. *30c.*

Ar7 (55) —— Metallic Implements of the New York Indians. 94p. 38pl. June 1902. *25c.*

Ar8 (73) —— Metallic Ornaments of the New York Indians. 122p. 37pl. Dec. 1903. *30c.*

Ar9 —— History of the New York Iroquois. *In press.*

—— Perch Lake Mounds. *In press.*

—— Aboriginal Use of Wood in New York. *In press.*

Miscellaneous. Ms1 (62) Merrill, F: J. H. Directory of Natural History Museums in United States and Canada. 236p. Ap. 1903. *30c.*

Ms2 (66) Ellis, Mary. Index to Publications of the New York State Natural History Survey and New York State Museum 1837-1902. 418p. June 1903. *75c, cloth.*

Museum memoirs 1889-date. Q.

1 Beecher, C: E. & Clarke, J: M. Development of some Silurian Brachiopoda. 90p. 8pl. Oct. 1889. *Out of print.*

2 Hall, James & Clarke, J: M. Paleozoic Reticulate Sponges. 350p. il. 70pl. 1898. *$1, cloth.*

3 Clarke, J: M. The Oriskany Fauna of Becraft Mountain, Columbia Co. *N. Y.* 128p. 9pl. Oct. 1900. 80c.

4 Peck, C: H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. *75c.*
This includes revised descriptions and illustrations of fungi reported in the 48th, 51st and 52d reports of the state botanist.

5 Clarke, J: M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. 196p. 21pl. July 1903. *$1.50, cloth.*

6 —— Naples Fauna in Western New York. 268p. 20pl. map. *$2, cloth.*

7 Ruedemann, Rudolf. Graptolites of New York. Pt 1 Graptolites of the Lower Beds. *In press.*

Felt, E. P. Insects Affecting Park and Woodland Trees. *In preparation.*

Natural history of New York. 30v. il. pl. maps. Q. Albany 1842-94.

DIVISION 1 ZOOLOGY. De Kay, James E. Zoology of New York; or, The New York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New York with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations. 5v. il. pl. maps. sq. Q. Albany 1842-44. *Out of print.*
Historical introduction to the series by Gov. W: H. Seward. 17p.

v. 1 pt1 Mammalia. 13+146p. 33pl. 1842.
300 copies with hand-colored plates.

v. 2 pt2 Birds. 12+380p. 141pl. 1844.
Colored plates.

v. 3 pt3 Reptiles and Amphibia. 7+98p. pt4 Fishes. 15+415p. 1842.
pt3-4 bound together.

v. 4 Plates to accompany v. 3. Reptiles and Amphibia 23pl. Fishes 79pl. 1842.
300 copies with hand-colored plates.

v. 5 pt5 Mollusca. 4+271p. 40pl. pt6 Crustacea. 70p. 13pl. 1843-44.
Hand-colored plates: pt5-6 bound together.

DIVISION 2 BOTANY. Torrey, John. Flora of the State of New York; comprising full descriptions of all the indigenous and naturalized plants hitherto discovered in the State, with remarks on their economical and medical properties. 2v. il. pl. sq. Q. Albany 1843. *Out of print.*

v. 1 Flora of the State of New York. 12+484p. 72pl. 1843.
300 copies with hand-colored plates.

v. 2 Flora of the State of New York. 572p. 89pl. 1843.
300 copies with hand-colored plates.

DIVISION 3 MINERALOGY. Beck, Lewis C. Mineralogy of New York; comprising detailed descriptions of the minerals hitherto found in the State of New York, and notices of their uses in the arts and agriculture. il. pl. sq. Q. Albany 1842. *Out of print.*

v. 1 pt1 Economical Mineralogy. pt2 Descriptive Mineralogy. 24+536p. 1842.
8 plates additional to those printed as part of the text.

DIVISION 4 GEOLOGY. Mather, W: W.; Emmons, Ebenezer; Vanuxem, Lardner & Hall, James. Geology of New York. 4v. il. pl. sq. Q. Albany 1842-43. *Out of print.*

v. 1 pt1 Mather, W: W. First Geological District. 37+653p. 46pl. 1843.

v. 2 pt2 Emmons, Ebenezer. Second Geological District. 10+437p. 17pl. 1842.

v. 3 pt3 Vanuxem, Lardner. Third Geological District. 306p. 1842.

v. 4 pt4 Hall, James. Fourth Geological District. 22+683p. 19pl. map. 1843

DIVISION 5 AGRICULTURE. Emmons, Ebenezer. Agriculture of New York; comprising an account of the classification, composition and distribution of the soils and rocks and the natural waters of the different geological formations, together with a condensed view of the meteorology and agricultural productions of the State. 5v. il. pl. sq. Q. Albany 1846-54. *Out of print.*

v. 1 Soils of the State, their Composition and Distribution. 11+371p. 21pl. 1846.

v. 2 Analysis of Soils, Plants, Cereals, etc. 8+343+46p. 42pl. 1849.
With hand-colored plates.

v. 3 Fruits, etc. 8+340p. 1851.

v. 4 Plates to accompany v. 3. 95pl. 1851.
Hand-colored.

v. 5 Insects Injurious to Agriculture. 8+272p. 50pl. 1854.
With hand-colored plates.

DIVISION 6 PALEONTOLOGY. Hall, James. Palaeontology of New York. 8v. il. pl. sq. Q. Albany 1847-94. *Bound in cloth.*

v. 1 Organic Remains of the Lower Division of the New York System. 23+338p. 99pl. 1847. *Out of print.*

v. 2 Organic Remains of Lower Middle Division of the New York System. 8+362p. 104pl. 1852. *Out of print.*

v. 3 Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone. pt1, text. 12+532p. 1859. [*$3.50*]

—— pt2. 143pl. 1861. [*$2.50*]

v. 4 Fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 11+1+428p. 99pl. 1867. *$2.50.*

v. 5 pt1 Lamellibranchiata 1. Monomyaria of the Upper Helderberg, Hamilton and Chemung Groups. 18+268p. 45pl. 1884. *$2.50.*

—— —— Lamellibranchiata 2. Dimyaria of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 62+293p. 51pl. 1885. *$2.50.*

—— pt2 Gasteropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 2v. 1879. v. 1, text. 15+492p. v. 2, 120pl. *$2.50 for 2 v.*

v. 6 Corals and Bryozoa of the Lower and Upper Helderberg and Hamilton Groups. 24+298p. 67pl. 1887. *$2.50.*

v. 7 Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups. 64+236p. 46pl. 1888. Cont. supplement to v. 5, pt2. Pteropoda, Cephalopoda and Annelida. 42p. 18pl. 1888. *$2.50.*

v. 8 pt1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16+367p. 44pl. 1892. *$2.50.*

—— pt2 Paleozoic Brachiopoda. 16+394p. 84pl. 1894. *$2.50.*

Catalogue of the Cabinet of Natural History of the State of New York and of the Historical and Antiquarian Collection annexed thereto. 242p. O. 1853.

Handbooks 1893-date. 7½x12½ cm.
In quantities, 1 cent for each 16 pages or less. Single copies postpaid as below.

H5 New York State Museum. 52p. il. *4c.*
Outlines history and work of the museum with list of staff 1902.

H13 Paleontology. 12p. *2c.*
Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology, Relation to stratigraphy; History of paleontology in New York.

H15 Guide to Excursions in the Fossiliferous Rocks of New York. 124p. *8c.*
Itineraries of 32 trips covering nearly the entire series of Paleozoic rocks, prepared specially for the use of teachers and students desiring to acquaint themselves more intimately with the fossiliferous rocks of this State.

H16 Entomology. 16p. *2c.*

H17 Economic Geology. *In press.*

H18 Insecticides and Fungicides. 20p. *3c.*

H19 Classification of New York Series of Geologic Formations. 32p. *3c.*

Maps. Merrill, F. J. H. Economic and Geologic Map of the State of New York; issued as part of Museum bulletin 15 and the 48th Museum Report. v. 1. 59x67 cm. 1894. Scale 14 miles to 1 inch. *Separate edition out of print.*

—— Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas form $3; mounted on rollers $5. Lower Hudson sheet 60c.*
The Lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam, Westchester, New York, Richmond, Kings, Queens and Nassau counties, and parts of Sullivan, Ulster and Suffolk counties; also northeastern New Jersey and part of western Connecticut.

—— Map of New York showing the Surface Configuration and Water Sheds. 1901. Scale 12 miles to 1 inch. *15c.*

Clarke, J. M. & Luther, D. D. Geologic Map of Canandaigua and Naples Quadrangles. 1904. *2 c.*
Issued as part of Paleontology 7.

AGRICULTURAL LIBRARY

Published monthly by the
University of the State of New York

BULLETIN 316 UNIVERSITY OF THE STATE OF NEW YORK 1904

New York State Museum

EPHRAIM PORTER FELT State Entomologist

Bulletin 76

ENTOMOLOGY 21

19th Report of the State Entomologist

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1903

	PAGE
Introduction	91
General entomologic features.	91
Office work	92
Special investigations	92
Publications	93
Collections of insects	94
Nursery inspection work	95
Voluntary observers	96
Acknowledgments	96
Beneficial insects	97
Synopsis of certain genera of the Ophionini	97
Injurious insects	125
Notes for the year	130
Plant lice	130
Fruit tree insects	137
Grapevine pests	142
Garden insects	143
Grain and house pests	145
Notes for the year (*continued*)	
Shade trees and forest insects.	147
Beneficial insects	150
Experimental work against San José scale insect	151
Early spring or winter applications	151
Summer washes	159
Diseased and dying trees and insect attack	167
Voluntary entomologic service	173
List of publications of the entomologist	192
Insect exchange	200
Species received in exchange	201
Exchange list	207
Contributions to collection	213
Explanation of plates	221
Plates 1-4	face 222
Index	223

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1904

Me1.06m-F4-1300

Price 15 cents

University of the State of New York

REGENTS 1908

With years of election

1892 WILLIAM CROSWELL DOANE D.D. LL.D. *Chancellor*, Albany
1878 WHITELAW REID M.A. LL.D. *Vice Chancellor* – New York
1877 CHAUNCEY M. DEPEW LL.D. – – – – New York
1877 CHARLES E. FITCH LL.B. M.A. L.H.D. – Rochester
1881 WILLIAM H. WATSON M.A. M.D. LL.D. – – Utica
1881 HENRY E. TURNER LL.D. – – – – Lowville
1883 ST CLAIR MCKELWAY M.A. L.H.D. LL.D. D.C.L. Brooklyn
1885 DANIEL BEACH Ph.D. LL.D. – – – – Watkins
1890 PLINY T. SEXTON LL.D. – – – – – Palmyra
1890 T. GUILFORD SMITH M.A. C.E. LL.D. – – Buffalo
1893 LEWIS A. STIMSON B.A. LL.D. M.D. – – – New York
1895 ALBERT VANDER VEER M.A. Ph.D. M.D. – Albany
1895 CHARLES R. SKINNER M.A. LL.D.
Superintendent of Public Instruction, ex officio
1897 CHESTER S. LORD M.A. LL.D. – – – – Brooklyn
1900 THOMAS A. HENDRICK M.A. LL.D. – – – Rochester
1901 BENJAMIN B. ODELL JR LL.D. Governor, ex officio
1901 ROBERT C. PRUYN M.A. – – – – Albany
1902 WILLIAM NOTTINGHAM M.A. Ph.D. LL.D. – Syracuse
1903 FRANK W. HIGGINS Lieutenant Governor, ex officio
1903 JOHN F. O'BRIEN Secretary of State, ex officio
1903 CHARLES A. GARDINER LL.B. M.A. Ph.D. LL.D. New York
1903 CHARLES S. FRANCIS B.S. – – – – Troy
One vacancy

SECRETARY

Elected by Regents

1900 JAMES RUSSELL PARSONS JR M.A. LL.D.

DIRECTORS OF DEPARTMENTS

1888 MELVIL DEWEY M.A. LL.D. *State Library and Home Education*
1890 JAMES RUSSELL PARSONS JR M.A. LL.D.
Administrative, College and High School Dep'ts
1890 FREDERICK J. H. MERRILL Ph.D. *State Museum*

University of the State of New York

New York State Museum

FREDERICK J. H. MERRILL Director
EPHRAIM PORTER FELT State Entomologist

Bulletin 76

ENTOMOLOGY 21

19th REPORT OF THE STATE ENTOMOLOGIST 1903

To the Regents of the University of the State of New York

I have the honor of presenting herewith my report on the injurious and other insects in the State of New York for the year ending Oct. 15, 1903.

General entomologic features. The season of 1903 will long be known on account of the abnormal abundance of plant lice of various species, which have not only been exceedingly destructive to fruit trees in particular but the prolongation of their depredations far beyond the usual date was specially injurious to young or recently set trees. The latter part of the summer the San José scale, Aspidiotus perniciosus Comst., bred so excessively that many trees were literally covered with half grown scale insects toward the end of the season. The depredations of the elm leaf beetle, Galerucella luteola Müll., have continued in the Hudson river valley though the spraying operations of recent years have reduced their numbers very largely in Albany and Troy. An interesting feature of this insect's history was its presence in excessive numbers at Saratoga Springs, where it would undoubtedly have caused severe injury had it not been for the prompt spraying instituted by the village authorities. The white marked tussock moth, Notolophus leucostigma Abb. & Sm., has caused less damage than usual in recent years

though it was generally present at Buffalo on a great many horse-chestnut trees, partially defoliating thousands. The fall web-worm, Hyphantria textor Harr., has, as a rule, been less injurious than in preceding years, except in a few localities.

Office work. The general office work has been conducted as in preceding years and has been marked by many more demands for information, indicating an increased interest. The determinations of scale insects for the commissioner of agriculture, in connection with the nursery inspection work of his department, has made somewhat extensive demands on the time of Assistant C. M. Walker, who has also had charge of most of the breeding cage work. Many photographs of living insects or specimens of their work have been taken and a number of lantern slides added to the collection, greatly increasing its effectiveness in illustrating popular lectures. It is gratifying to record that there have been no changes in the office staff during the past year, and consequently the work has proceeded without interruption from this cause. Correspondence indicates a continued and healthy interest in our work, as is evidenced by the following figures: 2035 letters, 784 postals, 490 circular letters and 1109 packages were sent through the mail during the past year. The reduction from last year in the number of postals and packages is due to the fact that but three publications were issued during the present year against four in 1903, and the last issued was not available for distribution till very late, consequently a portion of the copies will be sent out next year. Mailing expenses have also been reduced by sending two or more publications by express, wherever that was economical, a total of 114 packages being shipped.

Special investigations. The lines of work begun in earlier years have been continued and considerable progress made. The grape-vine root worm, Fidia viticida Walsh, has been the subject of more extended investigations than last year, a large amount of exceedingly valuable data has been secured and we have demonstrated that collecting the beetles was a practical, the most reliable and probably the most economical method of controlling this pest. The details of this work will appear in a revised and *extended bulletin* on this insect. The experiments with insecti-

cides for controlling the San José scale have been carried on in the same orchard as in the past three years, and our earlier results with crude petroleum have been confirmed. Extended experiments with lime-sulfur washes have also been conducted at Warwick with very gratifying results. An extensive series of experiments with summer washes was made, Mr Walker having direct charge of the work and being responsible for most of the observations. A second instalment of the beneficial Chinese ladybeetle, Chilocorus similis Rossi, which may prove of value in suppressing this pernicious scale insect, was obtained from the United States Department of Agriculture last August and established in an infested orchard at Kinderhook. It is hoped that they will survive in this latitude and prove of great value in controlling this dangerous pest. The extended forest fires in the Adirondacks early in the season offered an excellent opportunity for investigating the connection between them and insect attack. The results of this work are given on a subsequent page. Our general studies of forest and shade tree insects have been continued and a number of valuable observations made.

The present year has been marked by the appearance of a second report by Dr Needham on aquatic insects, which consists of a series of valuable original articles by himself, supplemented by important papers from Messrs MacGillivray, Johannsen and Davis. Another report by Dr Needham, is now in preparation and will be devoted largely to a consideration of the May flies and midges (Chironomidae) of the State.

Investigations on our native mosquitos have been continued, resulting in material additions to our knowledge. Collections of these little insects have been made in different sections of the State, and it was possible for Assistant D. B. Young to spend two weeks at Long Island, working in cooperation with the North Shore Improvement Association, which has become well and favorably known to all interested in this line of effort on account of its very efficient operations in subduing these pests in the vicinity of New York city.

Publications. The principal publications of the entomologist, to the number of 70 are listed under the usual head. The more

important of those issued during the past year are the following: *Grapevine Root Worm* (Museum bulletin 59), *18th Report of the State Entomologist 1902* (Museum bulletin 64) and *Aquatic Insects in New York State* (Museum bulletin 68). In addition, the entomologist has contributed an important paper on insects injurious to pine and oaks, for the seventh report of the Forest, Fish and Game Commission, and one on insecticides for the report of the Colorado State Board of Horticulture for 1902.

Other important publications, which are either in the printer's hands or practically completed, are as follows: *Grapevine Root Worm,* a revised and extended edition of Museum bulletin 59, mentioned above. A monograph of the genus Saperda, which includes some of our most destructive borers, has been prepared by the entomologist in association with Mr L. H. Joutel of New York city, and will form a small bulletin of about 80 pages illustrated by 7 colored plates. Dr Needham's third report, mentioned in the preceding paragraph, is practically completed and will be an extended work about the same size as Museum bulletin 68. There is also a memoir on insects injurious to forest and shade trees, an extensive publication illustrated with many halftones and 16 colored plates, treating specially of those forms which are destructive to shade trees.

Collections of insects. Very large additions have been made to the state collections during the past season. They are specially desirable because a considerable proportion have come from other sections of the State. Mr Young spent several weeks in the Adirondacks in special work on forest insects, and he has collected at intervals throughout the season in cooperation with the Vassar Brothers Institute, at Poughkeepsie, and also at Long Island while engaged on mosquito investigations. The results have been large and exceedingly valuable additions to the state collections. Much progress has been made in arranging insects previously collected. The Lepidoptera, which are in the care of Mr Walker, have all been referred to the principal groups and many determined specifically. He has also arranged the Coccidae, now represented by 98 species and a host of specimens, while Mr Young has been able to do considerable systematic work on the Tenthre-

dinidae, Ichneumonidae, Syrphidae, Tachinidae and Capsidae, besides making material progress in arranging the Coleoptera which, it is gratifying to state, are already in a fairly satisfactory condition. The exhibit collection has received valuable additions from time to time, and in all of our collecting an effort has been made to secure material desirable for this purpose. The museum was kindly remembered during the present year and bequeathed a small collection of insects by Miss Ellen L. Baker of Middle Granville N. Y.

The past season a system of exchange was inaugurated with most excellent results. The museum possesses large series of certain species. Lists were prepared and sent to entomologists in different sections of this and other countries with a request for exchanges, and as a result some exceedingly valuable additions have been made to the collection with practically no cost to the museum. The details of these exchanges together with a list of species available for this purpose will be found under a separate head.

Nursery inspection work. Owing to the Virginia authorities refusing in the fall of 1902 to accept nursery inspection certificates issued by the State Department of Agriculture, even though officially indorsed by us, other means had to be devised to aid those who wished to ship nursery stock into Virginia. The state entomologist of Virginia was willing to accept a certificate based on inspection by an assistant working under our direction, and as an accommodation to our nurserymen, it was arranged to send an assistant to make supplementary inspections of only that stock which was destined for Virginia, the parties benefited to pay his traveling expenses. Mr C. M. Walker was detailed for this work, which occupied nearly two weeks. It is very gratifying to state that the regular inspectors, in whom we have utmost confidence, kindly aided Mr Walker in his work. Mr H. C. Peck and Mr J. J. Barden, in whose territory most of the inspecting was done, were specially helpful. The following is a list of firms to whom these nursery certificates were issued between Oct. 21 and Nov. 1, respectively: Mt Hope Nurseries, Western New York Nursery Co., Thomas Bowman & Son, A. L. Wood, Allen Nursery Co., H. S. Taylor & Co., Charlton Nursery Co., all of Rochester; Sheeren

Wholesale Nurseries, George A. Sweet Nursery Co., Rogers Nursery, all of Dansville; Brown Bros. Co., Chase Bros. Co., First National Nurseries, Perry Nursery Co., J. B. Nellis & Co., all of Brighton; Lewis Roesch, T. S. Hubbard Co., G. S. Josselyn Co., all of Fredonia; Knight & Bostwick, Emmons & Co., and C. W. Stuart & Co., all of Newark.

Voluntary observers. The work of the voluntary observers begun in 1899 has been continued, but owing to an unusually dry spell in the early part of the season followed by excessive rains, there has been comparatively little to report except injuries by plant lice, a group of insects on which the voluntary observers are not well qualified to report. As a consequence, there are not so many records as have been made in earlier seasons, though the sum total of their observations amounts to a material addition to our knowledge concerning some very important injurious insects. Summaries of these reports are published under the usual head.

Acknowledgments. The untimely death of our highly esteemed and gifted associate, the late Prof. V. H. Lowe of the State Agricultural Experiment Station at Geneva, is a source of deep regret and a severe loss to the science he loved so well. The entomologist has been favored by the cooperation of a number of professional workers. To Dr L. O. Howard, chief of the division of entomology, United States Department of Agriculture, and his staff, special acknowledgments are due for the determination of a number of insects and for information regarding different species. Mr E. P. VanDuzee, of Buffalo, a well known authority on Hemiptera, has kindly identified all our Pentatomidae and a number of related forms, and we are indebted to Prof. Mel. T. Cook, of De Pauw University, Greencastle Ind., for the determination of many insect galls. The appreciation of our work by the many friends of the office is a source of pleasure, and the support given by those in authority is very gratifying.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

Office of the State Entomologist
Albany, Oct. 15, 1903

BENEFICIAL INSECTS

SYNOPSIS OF CERTAIN GENERA OF THE OPHIONINI

The following account of species belonging to various genera of this group is the result of a study, extending over some years, originally begun at Cornell University under the auspices of Prof. J. H. Comstock, to whom the writer is under deep obligations for assistance. The original assignment covered the species placed in this genus by Cresson, and owing to many other matters demanding attention, we have reluctantly decided to publish our results without attempting to extend our studies so as to include all the members of this group, particularly because of lack of time, and specially since a number of genera are represented only by foreign species. We also take this opportunity to express our obligations to Dr W. H. Ashmead, curator of the Hymenoptera, United States National Museum, who in recent years has kindly loaned us specimens and afforded material aid in our systematic study.

This group includes some of our larger and more common parasites, and to the species comprising it much credit is due for material aid in controlling a number of our insect pests. For example the long-tailed Ophion, E r e m o t y l u s m a c r u r u s Linn. is a common parasite of large cecropia larvae and allied species. These large caterpillars are rarely abundant enough to attract attention by their ravages, and one reason for this is undoubtedly the activity of their parasites, foremost of which stands the long-tailed Ophion.

Value as parasites

The other species of this group have been reared from a large number of hosts, and there is no reason for regarding several of them as of less value than E r e m o t y l u s m a c r u r u s Linn. The following statistics will give some idea of their abundance and, as the life of the host with its attendant possibilities is destroyed as each develops, they also give some idea of the economic value of the species. Six trap lanterns were in operation during the entire season of 1889 at Cornell University for the purpose of ascertaining the value of lights for destroying insects, and nearly

600 examples of ophionids were taken. Two species were well represented in this lot. There were none of the long-tailed Ophions, hence the figures give no idea of the relative abundance of this parasite or of the other species not represented. The one by far the most abundant was Ophion bilineatum Say, the two-lined Ophion, which was represented by 450 examples. The species next in abundance was Ophion tityri Pack., which was represented by 118 examples, while Eniscopilus purgatus Say was represented by but 23 individuals. It will be noticed that the two species taken most abundantly are not well represented in most collections and but little is known of their habits. This record does not in the least reflect on the value of these two as parasites. It is possible that both are equally efficient in their own fields and it is most probable, seeing that they are crepuscular or nocturnal in habit, that they breed largely in larvae which rarely fall into the hands of the collectors. The two-lined Ophion has been reared mostly from arctians or noctuids. Though records of this character are still far too scarce to permit the formation of a positive opinion, it is likely that this species does material service in keeping larvae belonging to these two families in check. The observations are even more meager regarding Ophion tityri. Here is certainly a field for investigation.

General habits

The different members of this group may usually be seen flying slowly about shrubbery and in the grass during bright days from early May till into October. In cloudy and wet weather they seek some sheltered place—at least this is true of the diurnal species. The long-tailed and the purged Ophions are the two taken most commonly in the day, and they are the best represented in most collections examined. The trap lantern record would appear to indicate a great preponderance of the two-lined Ophion. This must be ascribed to the crepuscular or nocturnal habits of the latter form. The females are the more active and are more abundant in collections. This might be expected, as on her devolves the labor of searching out a suitable nidus for

her eggs. The large proportion of females is well shown in the trap lantern record, where but 87 males were taken to 485 females. The great activity of the females and the large number of them attracted to lights must diminish materially the value of the trap lantern as a means of destroying insect pests.

Oviposition and larval habits

The females possess a sharp ovipositor which is capable of inflicting a slight wound. Its sharpness appears to be mainly for defensive purposes, as the eggs are deposited usually on the skin of the host, to which they firmly adhere by means of a cement or glue extruded at the moment of oviposition. The deposit of the egg by Eremotylus macrurus has been graphically described by Trouvelet as follows[1]: "When an Ichneumon detects the presence of a worm, she flies around it for a few seconds, and then rests upon the leaf near her victim; moving her antennae very rapidly above the body of the worm, but not touching it, and bending her abdomen under the breast, she seizes her ovipositor with the front legs, and waits for a favorable moment, when she quickly deposits a little oval white egg upon the skin of the larva. She is quiet for some time and then deposits another upon the larva, which only helplessly jerks its body every time an egg is laid." Eight to ten eggs are laid in this manner. A few days later they hatch and the larvae make their way under the skin of their victim, feeding on the fatty portions of the host at first, but later most of the tissues are devoured. The miserable victim of these parasites drags out a weary existence and usually perishes in the pupal state, rarely before. As a single larva will provide sustenance for the development of but one or two parasites, the weaker ones perish.

There is on the front tibia of Ophion an articulated, apical spine, a structure common to many Hymenoptera, which is possibly connected with the method of oviposition narrated above. This articulated spine is curved toward the tarsus near the apex, and might consequently be used for holding the ovipositor, be-

[1]1868 Am. Nat. 1 :89-91.

cause when apposed to the tarsus the bend is such as to allow the ovipositor to pass easily through a space between the two. It is worthy of note in this connection, as showing the method of depositing eggs by an insect belonging to the same family, that Thalessa has been seen ovipositing in a similar manner by reliable observers.[1]

Pupation and final transformations

The larva of Eremotylus macrurus usually pupates within the cocoon of its victim. As this species preys largely on the saturnians, the larvae of which spin stout cocoons, the grub of the parasite on emerging from the remains of its victim finds itself in a well protected cocoon, and consequently has no need of looking for a more secure place in which to undergo its final transformations. The same habit is probably common to other species infesting hosts spinning a stout cocoon, as, for example, Erem. aretiae when preying on these moths. The cocoons of Eniscopilus purgatus are found in the soil or under shelter near where its host has transformed. From the lack of evidence to the contrary, it may be presumed that such is the general habit of all the species infesting larvae that do not spin stout cocoons before pupation.

Very few notes exist on the duration of the pupa state in this genus. Riley states that the imagos of Erem. macrurus commonly emerge in the spring, and rarely come forth in the autumn. This would apparently indicate that the normal habit of this insect is to pass the winter in the pupal stage. An example of Enis. purgatus has been known to pupate July 24, the imago emerging Sep. 13.

Bibliography

1862 Packard, A. S. Me. Sci. Sur. Rep't, p.20 (Comes to light)
1869 —— Guide Study Ins. p.195 (Brief notice)
1863 Norton, Edward. Ent. Soc. Phila. Proc. 1:357-58 (Table of species)
1879 Provancher, *L'Abbé* L. Nat. Can. 11:115 (Generic characters), p.116-17 (Table of species)
1882 Lintner, J. A. Ins. N. Y. 1st Rep't, p.103-10 (Parasitic on Nephelodes violans)
1893 —— Ins. N. Y. 8th Rep't, p.238 (Mention)

[1] 1888 Lintner. Ins. N. Y. 4th Rep't, p.40-41.

1884 **Comstock, J. H.** Kingsley's Stand. Nat. Hist. 2:515 (Brief reference)
1895 —— Manual Study Ins. p.624, fig.750 (Notice)
1885 **Jack, J. G.** Can. Ent. 17:30 (Manner of oviposition on Notodonta concinna)
1886 —— Ent. Soc. Ont. 16th Rep't, p.16
1885 **Webster, F. M.** U. S. Dep't Agric. Rep't 1884, p.389 (Parasitic on Nematus)
1888 **Riley, C. V.** Insect Life, 1:171 (An external parasite)
1891 —— Insect Life, 3:276 (Feeding habits of larvae)
1893 —— Ent. Soc. Wash. Proc. 2:403 (Oviposition)
1890 **Bruner, Lawrence.** Neb. Agric. Exp. Sta. Bul. 14, p.62 (Parasitic on Acronycta lepusculina)
1891 **Forbes, S. A.** Ins. Ill. 17th Rep't, 1889-90, p.44 (Parasitic on white grub)
1891 **Riley, C. V. & Marlatt, C. L.** Insect Life, 4:179 (Ophion? parasitic on Nematus)
1894 **Smith, J. B.** N. J. Agric. Exp. Sta. Rep't, 1893, p.582 (General notice)

These are references to the genus only, as defined by Cresson in 1887.

Synopsis of genera treated

a Cubitodiscoidal nervure irregularly thickened, never appendiculate
  b Yellowish chitinous spots in cubitodiscoidal cell.....Eniscopilus *Curtis*
  bb No such spots in cubitodiscoidal cell.....Eremotylus *Forster*
aa Cubitodiscoidal nervure never irregularly thickened, usually appendiculate
  b Face normal.....Ophion *Gravenhorst*
  bb Face elongated.....Genophion *Felt*

Synopsis of species of Eremotylus

a Cubitodiscoidal vein usually strongly sinuate; hooks of hind wings 13-15; male clasps rather long, subrectangular, obtusely rounded at the apex.....macrurus Linn.
aa Cubitodiscoidal vein nearly arcuate; first and second recurrent nervures nearly equal; hooks of hind wing 7-9; male clasps subrectangular, acutely rounded.....arctiae Ashm.
glabratus Say[1]

Eremotylus macrurus Linn.

Long-tailed Ophion

This, the largest American species of the genus, is closely allied to Erem. arctiae Ashm., which has been confused with it in collections. The two species are easily separated from the others of the genus by their considerably larger size; the smallest being perceptibly larger than the largest of the other species, excepting

[1]See account of this species, p.106.

Ophion fuliginipennis Felt, which belongs in a different group. Erem. macrurus may be separated from Erem. arctiae by its larger size, by the fulvous tinge of the wings and veins, by the second discoidal nervure being nearly twice the length of the first, and by there being from 13 to 15 hooks on the hind wings. Other differences are detailed in the description of Erem. arctiae.

Habits and life history. This species is an active, diurnal insect, being rarely if ever attracted to lights. It is the one most commonly bred from the large saturnians, and is frequently referred to as a parasite of one or more of them. Its egg-laying habits and life history, so far as known, have been described in a preceding paragraph. It has also been recorded as bred from some of the arctians, but it is probable that some of these records really pertain to Erem. arctiae. Dr C. M. Weed has recorded an instance in which 30 out of 50 pupae of Samia columbia Smith were parasitized by this insect. The unusual abundance of Callosamia promethea Dr. is recorded in *Insect Life*, 2:383, and also the interesting fact that fully two thirds of the pupae harbored this parasite. The observations of Dr Riley show that this insect usually emerges in the spring, though occasionally individuals come forth in the autumn.

This parasite has been reared from the following insects: Isia isabella Abb. & Sm., Philosamia cynthia Drury, Callosamia promethea Drury, Samia columbia Smith, Samia cecropia Linn., Telia polyphemus Cram., Automeris io Fabr. and Apatelodes torrefacta Abb. & Sm.

Description. Fulvo-ferruginous, stigma almost obsolete; marginal nervure sinuate, thickened toward the stigma; size large; body 31 to 38 mm long; wing spread 43 to 56 mm. Head small, antennae nearly as long as the body; ocelli prominent, black; head yellowish posteriorly; eyes black, rather small; mandibles bidentate, tipped with black. Mesothorax convex; scutellum and postscutellum prominent; anterior portion of metathorax depressed; posterior portion rugose, limited anteriorly by a transverse carina; lateral carinae present. Wings hyaline; marginal nervure thickened, sinuate near the small stigma; cubitodiscoidal nervure never appendiculate, usually strongly sinuate; third *dis-*

coidal cell considerably wider at apex than base; hooks on hind wings 13 to 15. Legs long, honey yellow. Abdomen long, strongly compressed, usually darker at tip. Male claspers rather long, subrectangular, obtusely rounded at apex.

Described from 10 examples.

Cocoon. The larva leaves the shriveled remains of its victim when full grown and pupates within the cocoon spun before the demise of its host. The cocoon is tough, oval, about 32 mm long and 17 mm broad, and occupies the larger portion of that spun by its prey. It is composed of silk agglutinated by a dark secretion. Exteriorly it is a dark brown color, with a faint yellowish or golden band around the center. The interior is thinly lined with a transparent substance and possesses a brilliant metallic luster.

Distribution. The recorded distribution of this insect is from New England to California and from Canada to Texas, indicating that the species ranges over practically the whole of the United States and north into Canada. It has been reported from the following localities: Canada, New England, New York, New Jersey, Pennsylvania, District of Columbia, Virginia, Louisiana, Illinois, Missouri, Nebraska, Colorado, Texas, Nevada and California.

Specimens have also been examined from the following localities: Ottawa, Canada [Harrington]; New York city [Joutel]; Dutchess county, N. Y. and Rock Creek park, Washington D. C. [U. S. Nat. Mus.] and from Malden and Amherst Mass. [Fernald].

Bibliography

1846 Brulle, Auguste. Hist. Nat. Ins. Hymenopt. p.138. (Described as rugosus)

1862-63 Scudder, S. H. Bost. Soc. Nat. Hist. Proc. 9:188-89 (Mentioned as O. cecropiae)

1863 Norton, Edward. Ent. Soc. Phila. Proc. 1:359

1863 Sanborn, F. G. Mass. State Bd Agric. Rep't, p.169 (Mentioned as O. cecropiae)

1863 Trouvelet. Amer. Nat. 1:89-91, fig.1 (Method of oviposition, parasitic on Telea polyphemus)

1868 Smith. Ent. Soc. Lond. Proc. p.xxxii

1869 Packard, A. S. Guide Study Ins. p.195, fig.27 (Parasitic on Telea polyphemus)

1870 Riley, C. V. Am. Ent. 2:100, fig.63, 64

1872 —— Ins. Mo. 4th Rept, p.107-8, 129, fig.37, 38 (Parasitic on Samia cecropia, oviposition, habits of larva)
1880 —— Am. Ent. 3:134, fig.52 (Parasitic on Isia isabella)
1870 **Chambers, V. T.** Am. Ent. 2:156 (From Telea polyphemus)
1873 **Cresson, E. T.** Am. Ent. Soc. Trans. 4:169 (From Texas)
1875 —— Geol. and Geog. Sur. Ter. Rep't. Zool. 5:708 (From eastern Nevada)
1874 **Saunders, William.** Ent. Soc. Ont. 5th Rep't. p.25, fig.20, 21 (Parasitic on Samia cecropia, oviposition, habits of larva)
1875 —— —— 7th Rep't, p.42, fig.29, 42 (Parasitic on Telea polyphemus)
1883 —— —— 13th Rep't, p.17, fig.11 (Same as preceding)
1882 —— Can. Ent. 14:43, fig.7 (Same as preceding)
1883 —— Ins. Inj. Fruits. p.78, 175, 212, fig.73, 74 (Habits, parasitic on Samia cecropia, Telea polyphemus and Automeris io)
1876 **Worthington, C. E.** Can. Ent. 8:220 (Parasitic on Telea polyphemus)
1879 **Provancher,** *L'Abbé* **L.** Nat. Can. 11:116, 117 (Table of species, description)
1883 **Clarkson, Frederick.** Can. Ent. 15:162 (Describes cocoon, parasitic on Telea polyphemus)
1884 **Comstock, J. H.** Kingsley's Stand. Nat. Hist. 2:515, fig.643 (Habits, parasitic on Telea polyphemus)
1884 **Weed, C. M.** Papilio, 4:112 (Parasite of Samia columbia)
1887 **Waterhouse.** Ent. Soc. Lond. Proc. p.33 (Parasite of Callosamia promethea)
1889 **Fallou.** Ent. Soc. France Bul. 6, 9:cxxxii
1889 **Coquillett, D. W.** Insect Life, 1:286 (Mention)
1890 **Ashmead, W. H.** Col. Biol. Ass'n Bul. 1, p.43 (Listed)
1896 —— Am. Ent. Soc. Trans. 23:192 (Compared with Eremotylus arctiae)
1890 **Riley, C. V. & Howard, L. O.** Insect Life, 2:383 (Parasitic on Attacus promethea), 3:154 (Bred from Telea polyphemus, Samia cecropia, Apatelodes torrefacta)
1890 **Bruner, Lawrence.** Neb. Agric. Exp. Sta. Bul. 14, p.14, 15, fig.4, 5 (Parasitic on Samia cecropia)
1890 **Perkins, G. H.** Vt. State Bd Agric. 11th Rep't, separate, p.10 (Mention)
1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Listed)
1893-94 —— N. J. Agric. Exp. Sta. Rep't, p.582, fig.167. (Reference)
1896 —— Eco. Ent. p.382, fig.440 (Mention)
1900 —— Ins. N. J. p.580, fig.273 (Listed)
1891 **Lintner, J. A.** Ins. N. Y. 7th Rep't, p.228 (Parasitic on Isia isabella)
1891 **Harrington, W. W.** Ent. Soc. Ont. 21st Rep't, p.67, fig.31 (Parasitic on Telea polyphemus)
1892 **Osborn, Herbert.** Part. Cat. Animals Ia. p.15 (Listed)
1894 **Fyles, T. W.** Ent. Soc. Ont. 25th Rep't, p.55, fig.38 (Transforms within hosts—Saturniidae)
1896 **Evand, J. D.** Can. Ent. 28:10 (Listed)

Eremotylus arctiae Ashm.

This species is by no means rare, though not recognized as a distinct form till 1890 owing to its having been confused with Erem. macrurus, which it closely resembles. A critical examination of the material in the state collection, Dr Lintner's private collection, and that from Cornell University, lent by Professor Comstock, has resulted in the finding of several examples of this species. Two specimens were taken in the trap lanterns at Cornell; one Aug. 3 and the other Aug. 22, 1889. Owing to the kindness of Messrs Howard and Ashmead, we have been permitted to examine a type of this species.

Hosts. This species is parasitic mostly on some of the arctians, though it has also been reared from saturnians. The following hosts are known: Ecpantheria deflorata Fabr., Diacrisia virginica Fabr., Automeris io Fabr. and Callosamia promethea Drury.

Description. The following is Mr Ashmead's description:

In Erem. macrurus, the wings have a decided fulvous tinge and the veins are fulvous; the second recurrent nervure is about twice as long as the first recurrent nervure, the third discoidal cell, therefore, is much wider at apex than at base; in Erem. arctiae, the wings are entirely without the fulvous tinge and the basal nervure, tips of median and discal nervures vary from brown to black, or piceo-black; the second recurrent nervure is only slightly longer than the first recurrent nervure, the cubital nervure being arcuate and the third discoidal cell, therefore, is about as wide at apex as at base; in Erem. macrurus, the transverse metathoracic carina is always more or less distinctly sinuated at the middle, in Erem. arctiae it is straight. In Erem. arctiae the hooks on the hind wings vary from seven to nine; in Erem. macrurus they are from 13 to 15; in the former the claws are pectinate; in the latter simple.

Male 26 mm long, wing expanse 35 mm; female 20 to 28 mm long, wing expanse 36 to 40 mm.

Figure 6 on plate 2 represents the wing characters of Erem. macrurus. In Erem. arctiae the cubitodiscoidal nervure is arcuate; in the type examined it was a nearly perfect arc, but in other specimens there was a slight tendency to the

sinuous course usually so marked in Erem. macrurus. The form of the third discoidal cell in the type was a little more regular than in our specimens and the first and second recurrent nervures were more nearly of an equal length. The wings of Erem. arctiae appear to be proportionately wider than in Erem. macrurus. In a study of examples of Erem. macrurus, I find the claws pectinate as well as in Erem. arctiae. The claspers of the male in the former species are rather long, subrectangular and obtusely rounded at tip, while in the latter they are subtriangular and acutely rounded at tip.

Distribution. This species is probably as widely distributed over this county as is Erem. macrurus. It is known to occur in New York, New Jersey, District of Columbia, Alabama, Mississippi and California, and specimens are before the writer from the following localities: Ottawa, Canada [Harrington]; Malden and Amherst Mass. [Fernald]; Michigan, Onaga Kan., Santa Cruz mountains and bred from Halisidota agassizii by Coquillett, Los Angeles Cal. [U. S. Nat. Mus.] There is a specimen from Pennsylvania and one from Texas in the Museum of Comparative Zoology, Cambridge Mass.

Bibliography

1880 Riley, C. V. & Howard, L. O. Insect Life, 3:155 (Bred from Isia Isabella, Depantheria deflorata, Automeris io from Cal. as O. arctiae Riley M. S.)

1881 Lintner, J. A. Ins. N. Y. 7th Rep't, p.228 (Bred from Isia Isabella, as O. arctiae Riley M. S.)

1890 Ashmead, W. H. Am. Ent. Soc. Trans. 23:192 (Original description)

Eremotylus glabratus Say

This species is apparently quite closely related to Erem. arctiae Ashm. and it is possible that this is a synonym of Say's species but it may be determined certainty only by examining the type which is apparently in existence. A small example of [illegible] very well indexed with the [illegible] is a [illegible] of Natural [illegible]

adult accompanies it though a specimen of O. bilineatum Say was in close proximity to the cocoon. There is apparently nothing in that collection which can be used in the identification of this species. A specimen in the United States national collection has been labeled by Dr Ashmead as Eremotylus glabratus Say. It corresponds very closely with the description of Erem. arctiae. The most apparent differences are in its small size and the comparatively slender marginal or radial nervure with no distinct angle or tooth near the stigma, a character which is usually well marked in both Erem. macrurus Linn. and Erem. arctiae.

This species has undoubtedly been erroneously identified in a number of collections and the following references, except that of its original describer, in all probability relate to something else. Prof. G. C. Davis some years ago informed me that but one individual of this species was known to be in existence and that was in his possession. Say's original description of this insect is reproduced below:

Honey yellow; a glabrous spot in the large cubital cellule.

Body dull honey yellow; head bright yellow; antennae, mouth and stemmata honey-yellow; eyes blackish; wings, first cubital cellule beyond its middle with a longitudinally oval glabrous space, but destitute of any opaque spot; metathorax transversely wrinkled near the petiole of the abdomen.

Length about $\frac{1}{3}$ inch.

Bibliography

1835 **Say, Thomas.** Bost. Jour. Nat. Hist. 1:239 (Original description); same in Compl. Wr. LeConte ed. 2:695

1862 **Cresson, E. T.** Ent. Soc. Phila. Proc. 1:206 (Listed)

1863 **Norton, Edward.** Ent. Soc. Phila. Proc. 1:358

1890 **Riley, C. V. & Howard, L. O.** Insect Life, 3:155 (Bred from Hyphantria cunea)

1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Listed)

1899 —— Ins. N. J. sup. State Bd Agric. 27th Rep't. p.580 (Listed)

Table for separation of species of Eniscopilus

a Larger chitinous spot in glabrous area of cubitodiscoidal cell, not appendiculate.....purgatus Say

aa Larger chitinous spot in glabrous area of cubitodiscoidal cell, appendiculate

b Chitinous process extending from larger chitinous spot along the posterior margin of the glabrous area and partly around its distal portion. Male clasps obtusely rounded.....arcuatus Felt

bb Chitinous process from the larger spot not extending beyond the middle of the glabrous area. Smaller chitinous spot nearly circular and slightly posterior to the center of the glabrous area....
appendiculatus Felt

Eniscopilus purgatus Say

This species is easily recognized by the two opaque, chitinous spots in the cubitodiscoidal cell. The great tenuity and length of the basal two abdominal segments is very marked, and is frequently of service in identifying the insect, though this is also true of the much rarer Enis. arcuatus and Enis. appendiculatus. It is the species of this genus most frequently found in the East while collecting in the daytime and the one most common in collections.

Life history and habits. The imagos fly from the last of June till the last of September. They are diurnal and probably crepuscular in habit since they are attracted to lights to a certain extent, as is shown by the trap lantern experiments conducted at the Cornell University Agricultural Experiment Station in 1889.

Trap lantern records

	1889																			1892			
	JUNE				JULY							AUG.				SEP.			Total	JULY		AUG.	Total
	20	22	26	28	1	5	18	20	21	23	24	15	20	21	27	8	11	14		12	30	19	
Male.....	1	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	3	....	1	.....	1
Female..	1	1	2	1	...	1	1	2	2	...	1	1	1	2	1	1	1	1	20	1	....	2	3

It will be seen by examining the record for 1889, that there are three distinct periods, separated by a space of about two weeks, in which this species was taken. Thus none were captured between July 5 and 18, July 24 and Aug. 15. These two nonproductive periods may have been caused by climatic conditions, though it is hardly probable that unfavorable weather of any kind would prevent the species from flying by night for 13 consecutive days, to say nothing of the other period of three weeks. *It may be that* this periodicity indicates three broods or at least

periods when the imagos are more abundant, but in the absence of more data nothing but a surmise can be advanced.

The large number of females taken in the trap lantern reduces its value as a means of destroying noxious insects. Dr Packard observed that the bean-shaped egg of this insect was attached to the skin of the larval host by a pedicle, and that the newly hatched grub does not entirely leave the eggshell till it has eaten a hole into the side of its victim. It would therefore appear as though the sharpness of the ovipositor was largely for defensive purposes. The females can inflict a slight sting that will smart for half a minute or more, but the pain is by no means severe.

Hosts. This insect has been most frequently brought to notice as a parasite of the very destructive army worm, Heliophila unipuncta Haw. on which it is a very efficient check. The army worm was abundant in many localities throughout the country in 1896, when the numerous oblong, silken cocoons of this parasite attracted Professor Lugger's attention in Minnesota fields infested by army worms. This is the best evidence obtainable of its value as a parasite. We have reared it from the zebra caterpillar, Mamestra picta Harr. another injurious species, the grub emerging from the larva and pupating July 24, the adult appearing Sep. 13. Records indicate this to be one of the most valuable species of the genus, since it preys on several insects of considerable economic importance. It has been reared in addition to those named above, from Mamestra trifolii Rott, Scoliopteryx libatrix Linn., Schizura concinna Abb. & Sm., and S. unicornis Abb. & Sm. It has also been bred from a dipterous Solidago gall and several unidentified lepidopterous larvae. It probably has a number of other hosts. We have also seen a specimen reared from the Polyphemus caterpillar, Telea polyphemus Cram., in the Museum of Comparative Zoology at Cambridge Mass.

Description. Fulvo-ferruginous; stigma small; two subtriangular, opaque chitinous spots in the cubitodiscoidal cell.

Head medium; antennae nearly as long as the body; ocelli black, about equidistant from each other and the eyes; dorsal and posterior portions of head yellow; mandibles bidentate and tipped

with black. Thorax sericeous; mesothorax convex; scutellum and postscutellum prominent; metathorax slightly depressed anterior of the transverse carina; lateral carinae distinct. Wings hyaline; marginal nervure thickened and slightly sinuate near the stigma; cubitodiscoidal nervure usually strongly sinuate but not appendiculate, its bulla scarcely one fourth the width of the third discoidal cell from its apex; two subtriangular opaque spots occur in the glabrous area of the cubitodiscoidal cell, the larger one with no arcuate continuation along the margin of the glabrous area, though a small chitinous line may be seen near the smaller spot.

Legs honey yellow; abdomen strongly compressed, darker at the tip; first and second segments remarkably long and slender; claspers of male subtriangular, obliquely truncate, acute posteriorly.

Length about 22 mm, wing spread about 26 mm. Described from numerous examples.

The cocoon is a silken, brown, tough, oblong oval object.

Distribution. The recorded distribution of this insect is as follows: New England, New York, New Jersey, Pennsylvania, Virginia, Carolinas, Florida, Alabama, Illinois, Indiana, Missouri, Iowa, Colorado, Arizona, Nevada, California and Canada. Examples of this species from Georgia, Oregon and Washington, in addition to some of the states named above, occur in the collection of the Academy of Natural Sciences at Philadelphia. Specimens of this species are now before the writer from the following localities: Kansas; California; Virginia; Fox Point, Alaska [Harriman Expedition '99]; Flatbush N. Y., Victoria Tex., St Louis Mo., Durham N. H., and Arizona, all being in the collections of the United States National Museum. Specimens from Colorado, Las Vegas N. M., Cheyenne Wy., and Michigan were lent to the writer by Professor Gillette. Specimens from New York were received from Mr L. H. Joutel, and Mr W. W. Harrington kindly sent examples from Grimsby Ont. (taken June 6), Toronto (taken July 27, Aug. 24 and Sep. 3), Winnipeg (taken in June), Osoyoos B. C. (taken in May) and from Ottawa, Canada. Specimens from Malden and Amherst Mass. (taken Aug. 1, 2, 12 and 21) were lent to us by Prof. C. H. Fernald. The species is doubtless distributed over the whole of the United States and the larger portion of Canada.

Bibliography

1835 **Say, Thomas.** Bost. Jour. Nat. Hist. 1:238-39 (Original description)

1883 —— Compl. Wr. LeConte ed. 2:694 (Same as preceding)

1846 **Brulle, Auguste.** Hist. Nat. Ins. Hymenopt. p.141 (As O. lateralis)

1863 **Norton, Edward.** Ent. Soc. Phila. Proc. 1:206, 358 (Distribution)

1870 **Riley, C. V.** Ins. Mo. 2d Rep't, p.53, fig.25 (General notice)

1876 —— —— 8th Rep't, p.54, fig.38 (Parasite of Heliophila unipuncta, habitat, cocoon described)

1878 —— Mass. State Bd Agric. 25th Rep't, p.252 (Parasite of H. unipuncta)

1883 —— U. S. Ent. Com. 3d Rep't, p.128, pl.2, fig.5 (Parasite of H. unipuncta; eggs, habits of larva described)

1888 —— N. J. State Bd Agric. 15th An. Rep't 1887, p.523, fig.1 (Mention)

1875 **Cresson, E. T.** Geog. and Geol. Sur. Ter. Rep't. Zool. 5:708 (From eastern Nevada)

1879 **Provancher,** *L'Abbé* **L.** Nat. Can. 11:117 (Table of species of Ophion description)

1887 —— —— 16:34

1889 —— —— 19:248

1884 **Caulfield, F. B.** Can. Ent. 16:122-23 (Parasite of Mamestra picta; cocoon described)

1885 —— Ent. Soc. Ont. 15th Rep't, p.41 (Same as preceding)

1887 **Fletcher, James.** Cen. Exp. Farm (Can.) Rep't, p.29 (Parasite of Schizura concinna)

1888 **Lugger, Otto.** Univ. Minn. Bien. Rep't Regents, p.366-67, fig.31 (Parasites of H. unipuncta)

1896 —— Ent. Minn. Agric. Exp. Sta. 2d Rep't, p.17, fig.10 (Abundant in fields with army worm)

1896 —— Minn. Agric. Exp. Sta. Bul. 48, p.45, 46 (Same as preceding)

1890 **Webster, F. M.** U. S. Dep't Agric. Div. Ent. Bul. 22, p.46 (Reared from Scoliopteryx libatrix)

1893 —— O. Agric. Exp. Sta. Bul. 45, p.169

1890 **Ashmead, W. H.** Col. Biol. Ass'n Bul. 1, p.43 (Listed)

1890 **Riley, C. V. & Howard, L. O.** Insect Life, 2:382 (Reared from Scoliopteryx libatrix)

1890 —— —— 2:155 (Bred from Mamestra trifolia, Schizura unicornis et al)

1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.269 (Parasite of Schizura unicornis)

1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Listed)

1900 —— Ins. N. J. List, p.580, fig.274 (As Enicospilus)

1891 **Harrington, W. W.** Ent. Soc. Ont. 21st Rep't, p.67 (Parasite of army worm)

1892 **Osborn, Herbert.** Part. Cat. Animals Ia. p.15 (Listed)

1896 **Evans.** Can. Ent. 28:10 (Listed)

1897 **Panton.** Ent. Soc. Ont. 27th Rep't, p.51 (Parasite of army worm)

Eniscopilus arcuatus Felt

This comparatively rare species may be easily separated from E. p u r g a t u s Say, with which it has heretofore been confused, by the well marked chitinous, usually yellowish, arcuate continuation of the larger opaque spot in the cubitodiscoidal cell. This structure extends along the posterior border of the glabrous area in that cell to a point beyond the smaller opaque spot. It may also be recognized by the bulla of the cubitodiscoidal cell being at a distance equal to one half the width of the third discoidal cell from the apex of the same [pl. 1].

This species was described in the February issue of *Psyche*, 1902, page 307–8, and its characterization is reproduced herewith:

Light fulvo-ferruginous, the larger opaque chitinous spot of the cubitodiscoidal cell with a distinct arcuate continuation extending along the hinder margin of the glabrous area and partly around the smaller chitinous spot.

Head medium, yellowish posteriorly, face yellowish, antennae slightly longer than the body; ocelli black, equidistant; mandibles bidentate, fuscus apically. Thorax, sericeous; mesothorax, convex; scutellum and postscutellum, prominent, the former yellowish; metathorax slightly depressed in front of the transverse carina; lateral carinae distinct. Wings hyaline, having hardly a trace of the fuscus visible in O p h i o n (E n i s c o p i l u s) p u r g a t u s Say; marginal nervure slightly thickened and sinuate near the small stigma; cubitodiscoidal nervure, weakly sinuate, not appendiculate; its bulla one half the width of the third discoidal cell from its apex; two subtriangular opaque spots in the glabrous area of the cubitodiscoidal cell, the larger one with a chitinous, usually yellowish continuation along the hinder margin of the glabrous area to a point beyond the smaller chitinous spot, which latter is anterior and lateral of the center of the glabrous area. Legs, honey yellow. Abdomen, strongly compressed, slightly darker at the tip, the first and second segments being very slender. The claspers of the male are rounded apically.

Length about 23 mm. Wing spread from 30 to 35 mm.

Habitat, Albany N. Y. May 6, 1876 [W. M. Hill]; Ithaca N. Y., July 16, 1889 [J. M. Stedman]; New York city [L. H. Joutel]; Malden Mass. [C. H. Fernald]; Poughkeepsie N. Y. [Young, collector]; South Britain Ct. 1884 [G. F. Pierce].

There are examples of this species from Cambridge Mass. in the collection of the Museum of Comparative Zoology, and from Georgia and New Hampshire in the collection of the Academy of Natural Sciences of Philadelphia. There is a specimen in the collections of the United States National Museum labeled "Coll. C. V. Riley," and one in the Bolter Collection at the University of Illinois from Illinois. Types are in the New York State Museum and also at Cornell University.

Eniscopilus appendiculatus Felt

This form is even rarer than the preceding. It was originally described from one specimen which came into my possession through the kindness of Dr J. B. Smith, New Brunswick N. J. This specimen probably came from New Jersey and is deposited as a type in the New York State Museum. A study of the collections of others has revealed two specimens in the collections of the United States National Museum, one marked "Collection C. V. Riley" and the other "From Selma, October 1880, W. H. Patton." This form is evidently southern in its habitat and it may be separated from the preceding species by the following characteristics which were given in the February issue of *Psyche*, 1902, page 308:

Light fulvo-ferruginous, larger opaque spot of the cubitodiscoidal cell with a small extension on its posterior angle. The smaller chitinous spot is nearly circular, light yellow in color and slightly posterior to the center of the glabrous area [pl. 2, fig. 4].

This species differs in addition to the above characteristics from the preceding one in having the cubitodiscoidal nervure slightly angled and not sinuate. It is a smaller form, having a length of 18 mm and a wing spread of about 27 mm.

Table of species of Ophion

a Wings hyaline
  b Body usually strongly compressed, eyes large, extending nearly to the base of the mandibles
    c Medium size, metathorax not areolated, male clasps subtriangular ..... bilineatum Say
    cc Small, metathorax usually strongly areolated, male clasps short, rounded apically ..... tityri Pack.
  bb Body stout, not strongly compressed, eyes small, distant from base of mandibles

c Cubitodiscoidal nervure usually not appendiculate
d Ferruginous or fulvous.....**bifoveolatum** Brullé
dd Ferruginous varied with black and venter of mesothorax usually black .....**nigrovarium** Prov.
cc Cubitodiscoidal nervure appendiculate, appendix extending into second discoidal cell .....**abnormum** Felt
aa Wings subhyaline
b Wings distinctly ferruginous .....**ferruginipennis** Felt
bb Wings yellowish, fuscous along apical costal margin..**costale** Cress

Ophion bilineatum Say

Two-lined Ophion

This species, next to the long-tailed and purged Ophions, is the most abundant in collections and the one most frequently noticed in entomologic literature. It may be easily separated from the other more common forms by its medium to large size, strongly compressed abdomen, by the subtriangular, obliquely truncate male clasps and the appendiculate cubitodiscoidal nervure.

Life history and habits. Very little is recorded concerning the life history and habits of this species. Its comparative rarity in collections is probably explained by its crepuscular or nocturnal habits, since our trap lantern record indicates that it is one of the most abundant forms attracted to light.

Trap lantern records

| | 1889 | | |

It will be seen by the above, that there is some indication of periodicity in the captures, though nothing but what might be caused by more or less favorable weather or the relative abundance of the insects. There is certainly no indication of more than one brood. It will be noticed that this species flies most abundantly from about the middle to the last of September, and may be found on the wing till nearly the middle of October.

Hosts. Very little is known regarding the species on which this insect preys. The record is so meager that one can only surmise as to the economic value of this parasite. It has been reared from Diacrisia virginica Fabr. Feltia gladiaria Morrison, and Glaea inulta Grote. Dr Howard has recorded this species as possibly a parasite infesting Notolophus leucostigma Abb. & Sm. to a limited extent. This brief record suggests that this species may be parasitic on some of the arctians and noctuids, and while the former are not of much economic importance, such is not true of many of the latter, and in the control of these, this species may play an important part.

Description. Fulvo-ferruginous, stigma well developed, medium size to rather large; length of body about 19 mm; wing spread about 30 mm.

Head medium, antennae as long or longer than the body; eyes and ocelli black; lateral ocelli a little distant from the eyes; dorsal and dorsocaudal aspect of head yellowish; mandibles bidentate and tipped with black. Mesothorax convex; scutellum and postscutellum prominent; metathorax with inconstant raised lines. Wings hyaline with a glabrous elliptic spot near the stigma in the cubitodiscoidal cell; cubitodiscoidal nervure appendiculate [pl.2, fig.3], legs honey yellow. Abdomen rather strongly compressed, frequently a little darker at the extremity; male claspers subtriangular, obliquely truncate, and acute posteriorly.

Described from numerous specimens.

There are some very small representatives of this species from the Adirondack mountains that approach closely in size and general appearance the following form. They may be separated, however, by the relatively shorter, more compressed abdomen and by the thorax being as dark as other portions of the body.

Distribution. This insect has a wide distribution over the United States and the southern portion of Canada, though it has

sinuous course usually so marked in Erem. macrurus. The form of the third discoidal cell in the type was a little more regular than in our specimens and the first and second recurrent nervures were more nearly of an equal length. The wings of Erem. arctiae appear to be proportionately wider than in Erem. macrurus. In a study of examples of Erem. macrurus, I find the claws pectinate as well as in Erem. arctiae. The claspers of the male in the former species are rather long, subrectangular and obtusely rounded at tip, while in the latter they are subtriangular and acutely rounded at tip.

Distribution. This species is probably as widely distributed over this county as is Erem. macrurus. It is known to occur in New York, New Jersey, District of Columbia, Alabama, Mississippi and California, and specimens are before the writer from the following localities: Ottawa, Canada [Harrington]; Malden and Amherst Mass. [Fernald]; Michigan, Onaga Kan., Santa Cruz mountains and bred from Halisidota agassizii by Coquillett, Los Angeles Cal. [U. S. Nat. Mus.] There is a specimen from Pennsylvania and one from Texas in the Museum of Comparative Zoology, Cambridge Mass.

Bibliography

1890 **Riley, C. V. & Howard, L. O.** Insect Life, 3:155 (Bred from Isia isabella, Ecpantheria deflorata, Automeris io from Cal., as O. arctiae Riley M. S.)

1891 **Lintner, J. A.** Ins. N. Y. 7th Rep't, p.228 (Bred from Isia isabella, as O. arctiae Riley M. S.)

1896 **Ashmead, W. H.** Am. Ent. Soc. Trans. 23:192 (Original description)

Eremotylus glabratus Say

This species is apparently quite closely related to Erem. arctiae Ashm. and it is possible that this latter is a synonym of Say's species but that can be determined with certainty only by examining the type, which is apparently not in existence. A small example of Erem. arctiae corresponds very well indeed with the original description of this rare form. There is a cocoon in the Harris collection in the rooms of the Boston Society of Natural History, labeled "Ophion glabratum" but no

adult accompanies it though a specimen of O. bilineatum Say was in close proximity to the cocoon. There is apparently nothing in that collection which can be used in the identification of this species. A specimen in the United States national collection has been labeled by Dr Ashmead as Eremotylus glabratus Say. It corresponds very closely with the description of Erem. arctiae. The most apparent differences are in its small size and the comparatively slender marginal or radial nervure with no distinct angle or tooth near the stigma, a character which is usually well marked in both Erem. macrurus Linn. and Erem. arctiae.

This species has undoubtedly been erroneously identified in a number of collections and the following references, except that of its original describer, in all probability relate to something else. Prof. G. C. Davis some years ago informed me that but one individual of this species was known to be in existence and that was in his possession. Say's original description of this insect is reproduced below:

Honey yellow; a glabrous spot in the large cubital cellule.

Body dull honey yellow; head bright yellow; antennae, mouth and stemmata honey-yellow; eyes blackish; wings, first cubital cellule beyond its middle with a longitudinally oval glabrous space, but destitute of any opaque spot; metathorax transversely wrinkled near the petiole of the abdomen.

Length about $\frac{1}{5}$ inch.

Bibliography

1835 **Say, Thomas.** Bost. Jour. Nat. Hist. 1:239 (Original description); same in Compl. Wr. LeConte ed. 2:695

1862 **Cresson, E. T.** Ent. Soc. Phila. Proc. 1:206 (Listed)

1863 **Norton, Edward.** Ent. Soc. Phila. Proc. 1:358

1890 **Riley, C. V. & Howard, L. O.** Insect Life, 3:155 (Bred from Hyphantria cunea)

1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Listed)

1899 —— Ins. N. J. sup. State Bd Agric. 27th Rep't. p.580 (Listed)

Table for separation of species of Eniscopilus

a Larger chitinous spot in glabrous area of cubitodiscoidal cell, not appendiculate.....purgatus Say

aa Larger chitinous spot in glabrous area of cubitodiscoidal cell, appendiculate

b Chitinous process extending from larger chitinous spot along the posterior margin of the glabrous area and partly around its distal portion. Male clasps obtusely rounded.....arcuatus Felt

bb Chitinous process from the larger spot not extending beyond the middle of the glabrous area. Smaller chitinous spot nearly circular and slightly posterior to the center of the glabrous area....
appendiculatus Felt

Eniscopilus purgatus Say

This species is easily recognized by the two opaque, chitinous spots in the cubitodiscoidal cell. The great tenuity and length of the basal two abdominal segments is very marked, and is frequently of service in identifying the insect, though this is also true of the much rarer Enis. arcuatus and Enis. appendiculatus. It is the species of this genus most frequently found in the East while collecting in the daytime and the one most common in collections.

Life history and habits. The imagos fly from the last of June till the last of September. They are diurnal and probably crepuscular in habit since they are attracted to lights to a certain extent, as is shown by the trap lantern experiments conducted at the Cornell University Agricultural Experiment Station in 1889.

Trap lantern records

	1889																		1892			
	JUNE				JULY							AUG.				SEP.			Total	JULY	AUG.		Total
	20	22	26	28	1	5	18	20	21	23	24	15	20	21	27	8	11	14		12	30	19	
Male.....	1	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	3	....	1	.....	1
Female..	1	1	2	1	...	1	1	2	2	...	1	1	1	2	1	1	1	1	20	1	....	2	3

It will be seen by examining the record for 1889, that there are three distinct periods, separated by a space of about two weeks, in which this species was taken. Thus none were captured between July 5 and 18, July 24 and Aug. 15. These two nonproductive periods may have been caused by climatic conditions, though it is hardly probable that unfavorable weather of any kind would prevent the species from flying by night for 13 consecutive days, to say nothing of the other period of three weeks. It may be that this periodicity indicates three broods or at least

periods when the imagos are more abundant, but in the absence of more data nothing but a surmise can be advanced.

The large number of females taken in the trap lantern reduces its value as a means of destroying noxious insects. Dr Packard observed that the bean-shaped egg of this insect was attached to the skin of the larval host by a pedicle, and that the newly hatched grub does not entirely leave the eggshell till it has eaten a hole into the side of its victim. It would therefore appear as though the sharpness of the ovipositor was largely for defensive purposes. The females can inflict a slight sting that will smart for half a minute or more, but the pain is by no means severe.

Hosts. This insect has been most frequently brought to notice as a parasite of the very destructive army worm, Heliophila unipuncta Haw. on which it is a very efficient check. The army worm was abundant in many localities throughout the country in 1896, when the numerous oblong, silken cocoons of this parasite attracted Professor Lugger's attention in Minnesota fields infested by army worms. This is the best evidence obtainable of its value as a parasite. We have reared it from the zebra caterpillar, Mamestra picta Harr. another injurious species, the grub emerging from the larva and pupating July 24, the adult appearing Sep. 13. Records indicate this to be one of the most valuable species of the genus, since it preys on several insects of considerable economic importance. It has been reared in addition to those named above, from Mamestra trifolii Rott, Scoliopteryx libatrix Linn., Schizura concinna Abb. & Sm., and S. unicornis Abb. & Sm. It has also been bred from a dipterous Solidago gall and several unidentified lepidopterous larvae. It probably has a number of other hosts. We have also seen a specimen reared from the Polyphemus caterpillar, Telea polyphemus Cram., in the Museum of Comparative Zoology at Cambridge Mass.

Description. Fulvo-ferruginous; stigma small; two subtriangular, opaque chitinous spots in the cubitodiscoidal cell.

Head medium; antennae nearly as long as the body; ocelli black, about equidistant from each other and the eyes; dorsal and posterior portions of head yellow; mandibles bidentate and tipped

with black. Thorax sericeous; mesothorax convex; scutellum and postscutellum prominent; metathorax slightly depressed anterior of the transverse carina; lateral carinae distinct. Wings hyaline; marginal nervure thickened and slightly sinuate near the stigma; cubitodiscoidal nervure usually strongly sinuate but not appendiculate, its bulla scarcely one fourth the width of the third discoidal cell from its apex; two subtriangular opaque spots occur in the glabrous area of the cubitodiscoidal cell, the larger one with no arcuate continuation along the margin of the glabrous area, though a small chitinous line may be seen near the smaller spot.

Legs honey yellow; abdomen strongly compressed, darker at the tip; first and second segments remarkably long and slender; claspers of male subtriangular, obliquely truncate, acute posteriorly.

Length about 22 mm, wing spread about 26 mm. Described from numerous examples.

The cocoon is a silken, brown, tough, oblong oval object.

Distribution. The recorded distribution of this insect is as follows: New England, New York, New Jersey, Pennsylvania, Virginia, Carolinas, Florida, Alabama, Illinois, Indiana, Missouri, Iowa, Colorado, Arizona, Nevada, California and Canada. Examples of this species from Georgia, Oregon and Washington, in addition to some of the states named above, occur in the collection of the Academy of Natural Sciences at Philadelphia. Specimens of this species are now before the writer from the following localities: Kansas; California; Virginia; Fox Point, Alaska [Harriman Expedition '99]; Flatbush N. Y., Victoria Tex., St Louis Mo., Durham N. H., and Arizona, all being in the collections of the United States National Museum. Specimens from Colorado, Las Vegas N. M., Cheyenne Wy., and Michigan were lent to the writer by Professor Gillette. Specimens from New York were received from Mr L. H. Joutel, and Mr W. W. Harrington kindly sent examples from Grimsby Ont. (taken June 6), Toronto (taken July 27, Aug. 24 and Sep. 3), Winnipeg (taken in June), Osoyoos B. C. (taken in May) and from Ottawa, Canada. Specimens from Malden and Amherst Mass. (taken Aug. 1, 2, 12 and 21) were lent to us by Prof. C. H. Fernald. The species is doubtless distributed over the whole of the United States and the larger portion of Canada.

Bibliography

1835 **Say, Thomas.** Bost. Jour. Nat. Hist. 1:238-39 (Original description)

1883 —— Compl. Wr. LeConte ed. 2:694 (Same as preceding)

1846 **Brulle, Auguste.** Hist. Nat. Ins. Hymenopt. p.141 (As O. lateralis)

1863 **Norton, Edward.** Ent. Soc. Phila. Proc. 1:206, 358 (Distribution)

1870 **Riley, C. V.** Ins. Mo. 2d Rep't, p.53, fig.25 (General notice)

1876 —— —— 8th Rep't, p.54, fig.38 (Parasite of Heliophila unipuncta, habitat, cocoon described)

1878 —— Mass. State Bd Agric. 25th Rep't, p.252 (Parasite of H. unipuncta)

1883 —— U. S. Ent. Com. 3d Rep't, p.128, pl.2, fig.5 (Parasite of H. unipuncta; eggs, habits of larva described)

1888 —— N. J. State Bd Agric. 15th An. Rep't 1887, p.523, fig.1 (Mention)

1875 **Cresson, E. T.** Geog. and Geol. Sur. Ter. Rep't. Zool. 5:708 (From eastern Nevada)

1879 **Provancher,** *L'Abbé* **L.** Nat. Can. 11:117 (Table of species of Ophion description)

1887 —— —— 16:34

1889 —— —— 19:248

1884 **Caulfield, F. B.** Can. Ent. 16:122-23 (Parasite of Mamestra picta; cocoon described)

1885 —— Ent. Soc. Ont. 15th Rep't, p.41 (Same as preceding)

1887 **Fletcher, James.** Cen. Exp. Farm (Can.) Rep't, p.29 (Parasite of Schizura concinna)

1888 **Lugger, Otto.** Univ. Minn. Bien. Rep't Regents, p.366-67, fig.31 (Parasites of H. unipuncta)

1896 —— Ent. Minn. Agric. Exp. Sta. 2d Rep't, p.17, fig.10 (Abundant in fields with army worm)

1896 —— Minn. Agric. Exp. Sta. Bul. 48, p.45, 46 (Same as preceding)

1890 **Webster, F. M.** U. S. Dep't Agric. Div. Ent. Bul. 22, p.46 (Reared from Scolioptéryx libatrix)

1893 —— O. Agric. Exp. Sta. Bul. 45, p.169

1890 **Ashmead, W. H.** Col. Biol. Ass'n Bul. 1, p.43 (Listed)

1890 **Riley, C. V. & Howard, L. O.** Insect Life, 2:382 (Reared from Scolioptéryx libatrix)

1890 —— —— 2:155 (Bred from Mamestra trifolia, Schizura unicornis et al)

1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p.269 (Parasite of Schizura unicornis)

1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Listed)

1900 —— Ins. N. J. List, p.580, fig.274 (As Enicospilus)

1891 **Harrington, W. W.** Ent. Soc. Ont. 21st Rep't, p.67 (Parasite of army worm)

1892 **Osborn, Herbert.** Part. Cat. Animals Ia. p.15 (Listed)

1896 **Evans.** Can. Ent. 28:10 (Listed)

1897 **Panton.** Ent. Soc. Ont. 27th Rep't, p.51 (Parasite of army worm)

Eniscopilus arcuatus Felt

This comparatively rare species may be easily separated from E. p u r g a t u s Say, with which it has heretofore been confused, by the well marked chitinous, usually yellowish, arcuate continuation of the larger opaque spot in the cubitodiscoidal cell. This structure extends along the posterior border of the glabrous area in that cell to a point beyond the smaller opaque spot. It may also be recognized by the bulla of the cubitodiscoidal cell being at a distance equal to one half the width of the third discoidal cell from the apex of the same [pl. 1].

This species was described in the February issue of *Psyche*, 1902, page 307–8, and its characterization is reproduced herewith:

Light fulvo-ferruginous, the larger opaque chitinous spot of the cubitodiscoidal cell with a distinct arcuate continuation extending along the hinder margin of the glabrous area and partly around the smaller chitinous spot.

Head medium, yellowish posteriorly, face yellowish, antennae slightly longer than the body; ocelli black, equidistant; mandibles bidentate, fuscus apically. Thorax, sericeous; mesothorax, convex; scutellum and postscutellum, prominent, the former yellowish; metathorax slightly depressed in front of the transverse carina; lateral carinae distinct. Wings hyaline, having hardly a trace of the fuscus visible in O p h i o n (E n i s c o p i l u s) p u r g a t u s Say; marginal nervure slightly thickened and sinuate near the small stigma; cubitodiscoidal nervure, weakly sinuate, not appendiculate; its bulla one half the width of the third discoidal cell from its apex; two subtriangular opaque spots in the glabrous area of the cubitodiscoidal cell, the larger one with a chitinous, usually yellowish continuation along the hinder margin of the glabrous area to a point beyond the smaller chitinous spot, which latter is anterior and lateral of the center of the glabrous area. Legs, honey yellow. Abdomen, strongly compressed, slightly darker at the tip, the first and second segments being very slender. The claspers of the male are rounded apically.

Length about 23 mm. Wing spread from 30 to 35 mm.

Habitat, Albany N. Y. May 6, 1876 [W. M. Hill]; Ithaca N. Y., July 16, 1889 [J. M. Stedman]; New York city [L. H. Joutel]; Malden Mass. [C. H. Fernald]; Poughkeepsie N. Y. [Young, collector]; South Britain Ct. 1884 [G. F. Pierce].

There are examples of this species from Cambridge Mass. in the collection of the Museum of Comparative Zoology, and from Georgia and New Hampshire in the collection of the Academy of Natural Sciences of Philadelphia. There is a specimen in the collections of the United States National Museum labeled "Coll. C. V. Riley," and one in the Bolter Collection at the University of Illinois from Illinois. Types are in the New York State Museum and also at Cornell University.

Eniscopilus appendiculatus Felt

This form is even rarer than the preceding. It was originally described from one specimen which came into my possession through the kindness of Dr J. B. Smith, New Brunswick N. J. This specimen probably came from New Jersey and is deposited as a type in the New York State Museum. A study of the collections of others has revealed two specimens in the collections of the United States National Museum, one marked "Collection C. V. Riley" and the other "From Selma, October 1880, W. H. Patton." This form is evidently southern in its habitat and it may be separated from the preceding species by the following characteristics which were given in the February issue of *Psyche*, 1902, page 308:

Light fulvo-ferruginous, larger opaque spot of the cubitodiscoidal cell with a small extension on its posterior angle. The smaller chitinous spot is nearly circular, light yellow in color and slightly posterior to the center of the glabrous area [pl. 2, fig. 4].

This species differs in addition to the above characteristics from the preceding one in having the cubitodiscoidal nervure slightly angled and not sinuate. It is a smaller form, having a length of 18 mm and a wing spread of about 27 mm.

Table of species of Ophion

a Wings hyaline
  b Body usually strongly compressed, eyes large, extending nearly to the base of the mandibles
    c Medium size, metathorax not areolated, male clasps subtriangular ..... bilineatum Say
    cc Small, metathorax usually strongly areolated, male clasps short, rounded apically ..... tityri Pack.
  bb Body stout, not strongly compressed, eyes small, distant from base of mandibles

c Cubitodiscoidal nervure usually not appendiculate
d Ferruginous or fulvous.....bifoveolatum Brullé
dd Ferruginous varied with black and venter of mesothorax usually black .....nigrovarium Prov.
cc Cubitodiscoidal nervure appendiculate, appendix extending into second discoidal cell .....abnormum Felt
aa Wings subhyaline
b Wings distinctly ferruginous .....ferruginipennis Felt
bb Wings yellowish, fuscous along apical costal margin..costale Cress

Ophion bilineatum Say

Two-lined Ophion

This species, next to the long-tailed and purged Ophions, is the most abundant in collections and the one most frequently noticed in entomologic literature. It may be easily separated from the other more common forms by its medium to large size, strongly compressed abdomen, by the subtriangular, obliquely truncate male clasps and the appendiculate cubitodiscoidal nervure.

Life history and habits. Very little is recorded concerning the life history and habits of this species. Its comparative rarity in collections is probably explained by its crepuscular or nocturnal habits, since our trap lantern record indicates that it is one of the most abundant forms attracted to light.

Trap lantern records

| | 1889 | | |

It will be seen by the above, that there is some indication of periodicity in the captures, though nothing but what might be caused by more or less favorable weather or the relative abundance of the insects. There is certainly no indication of more than one brood. It will be noticed that this species flies most abundantly from about the middle to the last of September, and may be found on the wing till nearly the middle of October.

Hosts. Very little is known regarding the species on which this insect preys. The record is so meager that one can only surmise as to the economic value of this parasite. It has been reared from Diacrisia virginica Fabr. Feltia gladiaria Morrison, and Glaea inulta Grote. Dr Howard has recorded this species as possibly a parasite infesting Notolophus leucostigma Abb. & Sm. to a limited extent. This brief record suggests that this species may be parasitic on some of the arctians and noctuids, and while the former are not of much economic importance, such is not true of many of the latter, and in the control of these, this species may play an important part.

Description. Fulvo-ferruginous, stigma well developed, medium size to rather large; length of body about 19 mm; wing spread about 30 mm.

Head medium, antennae as long or longer than the body; eyes and ocelli black; lateral ocelli a little distant from the eyes; dorsal and dorsocaudal aspect of head yellowish; mandibles bidentate and tipped with black. Mesothorax convex; scutellum and postscutellum prominent; metathorax with inconstant raised lines. Wings hyaline with a glabrous elliptic spot near the stigma in the cubitodiscoidal cell; cubitodiscoidal nervure appendiculate [pl.2, fig.3], legs honey yellow. Abdomen rather strongly compressed, frequently a little darker at the extremity; male claspers subtriangular, obliquely truncate, and acute posteriorly.

Described from numerous specimens.

There are some very small representatives of this species from the Adirondack mountains that approach closely in size and general appearance the following form. They may be separated, however, by the relatively shorter, more compressed abdomen and by the thorax being as dark as other portions of the body.

Distribution. This insect has a wide distribution over the United States and the southern portion of Canada, though it has

not been reported from every state in the Union. Its recorded distribution is as follows: New England, New York, New Jersey, Virginia, Maryland, District of Columbia, Florida, Louisiana, Michigan, Iowa, Missouri, Colorado, Texas, Montana, Nevada, Lake Winnipeg and Sudbury, Ontario.

Bibliography

1828 **Say, Thomas.** Macl. Lyc. Arts Sci. Contrib. p.75 (Original description)
1835 —— —— Bost. Jour. Nat. Hist. 1:248 (Mention)
1883 —— —— Compl. Wr. LeConte ed. 1:378 (Habitat Indiana)
1862 **Cresson, E. T.** Ent. Soc. Phila. Proc. 1:206 (Listed)
1873 —— Am. Ent. Soc. Trans. 4:169 (In Texas)
1875 —— Geog. and Geol. Sur. Ter. Rep't Zool. 5:708 (From eastern Nevada)
1863 **Norton, Edward.** Ent. Soc. Phila. Proc. 1:358 (Distribution)
1863 **Sanborn, F. G.** Mass. State Bd. Agric. Rep't, p.169 (Bilineatus mentioned)
1871 **Riley, C. V.** Ins. Mo. 3d Rep't, p.69 (Parasite of Spilosoma virginica)
—— N. Am. Fauna no.7, p.247 (Sonoma county, Cal.)
1879 **Provancher,** *L'Abbé* **L.** Nat. Can. 11:117-18, fig.4 (Table of species, description)
1887 —— —— 16:34 (Listed)
1882 **Packard, A. S.** Bost. Soc. Nat. Hist. Proc. 21:19 (O. tityri separated from this species)
1883 **Saunders, William.** Ins. Inj. Fruits, p.273, fig.282 (Parasite of Spilosoma virginica)
1888 **Lintner, J. A.** Ins. N. Y. 4th Rep't, p.205 (At Coeyman N. Y.)
1889 **Scudder, S. H.** Butterflies of N. Eng. 3:1880, pl.88, fig.8 (O. tityri supposed to be a variety)
1890 **Riley, C. V. & Howard, L. O.** Insect Life, 3:155 (Bred from Glaea inulta and Agrotis morrisoniana, *habitat*)
1890 **Ashmead, W. H.** Col. Biol. Ass'n Bul. 1, p.43 (Listed)
1890 **Perkins, C. H.** Vt. State Bd. Agric. 11th Rep't, separate, p.10 (Mention)
1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Not common at Caldwell)
1891 **Harrington, W. H.** Ent. Soc. Ont. 21st Rep't, p.67 (Parasite of white miller moths)
1892 **Osborn, Herbert.** Part. Cat. Animals Ia. p.15 (Common)
1896 **Evans, J. D.** Can. Ent. 28:10 (Listed)
1897 **Howard, L. O.** U. S. Dep't Agric. Div. Ent. Bul. 5, Tech. Ser. p.30 (Possibly a parasite of Orgyia leucostigma)

Ophion tityri Pack.

This species resembles O. bilineatum Say closely in its general appearance, and it may be an earlier occurring dimor-

phic form but we have no evidence of this and for the present it must be regarded as a distinct species. It may be separated from the preceding by its smaller size, relatively shorter and flatter abdomen, and by the difference in the form of the male genitalia.

Life history and habits. Comparatively little is known of the life history and habits of this insect, since it has been so frequently confused with O. b i l i n e a t u m . There appears to be but one published notice of this parasite since its description in 1882, and in that it is not recognized as a distinct form. This species can hardly be regarded as rare, since over 100 individuals were taken in the trap lantern experiments at Cornell University and it has been frequently collected by the writer and also met with in other collections.

Trap lantern records

	1889																			
	MAY																			
	5	7	8	9	10	11	14	15	16	17	18	19	20	21	22	24	25	26	28	
Male	....	....	1	....	....	1	2	1	2	2	4	10	2	1	2	1	3	2	1	
Female	1	1	1	3	1	1	3	1	9	4	1	7	3	4	1	3	3	3	....	

	1889																			
	JUNE													JULY					AUG.		
	2	3	4	5	6	8	11	13	16	17	19	27	29	1	2	3	23	31	1	2	17
Male	....	1	....	....	....	2	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....
Female	2	2	1	1	2	1	1	1	2	2	1	1	2	1	1	1	3	1	2	1	1

	1889			1892																			
	SEP.		Total	MAY	JUNE									JULY						AUG.			Total
	27	30		26	1	2	4	5	9	19	21	28	1	6	16	17	25	26	28	2	6	
Male	....	....	39	....	1	1	1	1	1	....	....	....	....	....	2	....	....	....	....	....	....	7
Female	1	1	79	1	....	1	1	....	....	3	1	1	1	1	....	1	1	1	1	1	1	16

A glance at the above table will show that this insect has a well defined period of flight, and one that does not overlap the time O. bilineatum is abroad, except in the case of scattering individuals. This species appears early in May, is most abundant the latter part of the month, and occurs somewhat rarely during June with belated individuals in July, August and September, while O. bilineatum does not occur till August and then only in scattering numbers till the latter part of the month. This marked difference in the time of flight between these two parasites indicates that either they are two broods of the same insect or else that they are distinct species. The structural difference to be described later must be regarded as proofs of their distinctness. The large eyes and many individuals taken in the trap lantern indicate a crepuscular or nocturnal habit.

Hosts. This parasite has been reared from Epargyreus tityrus Fabr. Prof. G. C. Davis, when at the Michigan Agricultural College Experiment Station, wrote us that he had bred the insect repeatedly from Halisidota caryae Harris and Symmerista albifrons Abb. & Sm. It is probably parasitic on a number of other related insects.

Description. Ferruginous or fulvo-ferruginous with frequently a decidedly fulvous tinge on the thorax, which latter is shorter and the abdomen considerably shorter than in O. bilineatus.

Face ferruginous, or laterally fulvous; head medium; mandibles bidentate, tipped with dark brown, clypeal fossae deep, antennae usually longer than the body; the fossae at their bases not deep; eyes large, reaching nearly to the base of the mandibles. Ocelli black, nearly contiguous and the posterior close to the eyes. Thorax short, ferruginous or fulvo-ferruginous; mesothorax convex; scutellum and postscutellum prominent; metathorax usually with very prominent carinae inclosing deep, four sided areas, and the pedicel of the abdomen surrounded by a high carina. Wings hyaline; cubitodiscoidal nervure strongly appendiculate. First recurrent nervure only about one third the length of the second; bulla of the latter close to the cubitodiscoidal nervure, and that of the latter nearer the second discoidal nervure than the appendix. Legs long, fulvo-ferruginous; abdomen much shorter than in O. bilineatus, very strongly compressed and the posterior segments usually darker in color. Clasps of male subtriangular, obtusely rounded, length 14 mm. wing spread 26 to 30 mm. Described from numerous specimens of both sexes.

Distribution. This species is widely and probably generally distributed in the northern United States and southern Canada. It was described from Massachusetts, has been met with in numbers at both Albany and Ithaca N. Y. and was repeatedly reared by Professor Davis in Michigan. In addition we have specimens before us from New York city [Joutel]; Ottawa, May 19, 24 and June 8, Toronto, August 24, Grimsby, June 6, Port Hope, May 5, and Vancouver Island, May 3, all from Canada through the kindness of Mr W. H. Harrington.

Bibliography

1882 **Packard, A. S.** Bost. Soc. Nat. Hist. Proc. 21:19 (Original description)

1889 **Scudder, S. H.** Butterflies N. Eng. 3:1872, 1880, pl.88, fig.8 (As O. bilineatum; parasite of Epargyreus tityrus)

Ophion bifoveolatum Brullé

This species is one of the more common forms belonging to the genus and if one may judge from trap lantern records, it is largely diurnal and not crepuscular or nocturnal as in the case of some of its close allies. This conclusion is further borne out by the reduced size of the eyes, being decidedly smaller than in related species and distant from the mandibles. This species occurred in the trap lantern material taken at Ithaca in very small numbers compared to those of the closely allied Ophion bilineatum Say. It has a somewhat exceptional host in white grubs, compared with other members of the genus and so far as known to us has not been reared from any other species.

Description. Fulvo-ferruginous with small eyes distant from mouth; costal vein inclined to black; cubitodiscoidal nervure rarely appendiculate; bulla of the second recurrent nervure usually close to tip of cubitodiscoidal nervure and abdomen less compressed than in its close allies.

Head medium; face frequently fulvous laterally, broad; mandibles stout with black tips; clypeal fossae deep and usually black; antennae dark brown, stout and not as long as the body; ocelli black and equidistant. Thorax sometimes dark brown, finely punctured and with sutures more or less black; mesothorax convex; scutellum and postscutellum prominent, the former sometimes a light ferruginous; dorsum of metathorax is usually smooth. Wings hyaline; stigma well developed; costal

and adjacent veins inclined to black; cubitodiscoidal vein usually smoothly arched and rarely appendiculate; bulla of second recurrent nervure usually close to tip of cubitodiscoidal nervure [pl. 2, fig. 2]. Legs uniformly ferruginous; claws pectinate. Abdomen sometimes slightly darker at tip and not strongly compressed but relatively thicker and shorter. Male clasps stout, rather long, obliquely rounded and rather acute at tip.

Length about 15 mm. Wing spread about 28 mm.

This species occurs abroad during the latter part of May and very early in June. Specimens are at hand from Ottawa, Canada taken May 30 and June 6 [Harrington]; Fort Lee N.J. taken May 29 [Joutel]; Malden Mass. taken May 4 [Fernald]; Belfrage Tex., Washington D.C., taken in May [United States National Museum] besides various New York localities. This species has been recorded from the following localities: Mt Washington N. H., New Jersey, New York, Illinois, Iowa, Colorado and Texas. The record of captures in trap lanterns at Ithaca in 1889 and 1892 is given below:

Trap lantern records

	1889								1892								
	MAY		JUNE					Total	MAY	JUNE							Total
	24	26	3	4	8	21	28		30	1	2	3	6	11	16	25	28	
Male											1			1	1			3
Female	1	1	1	1	1	1	1	7	3	2	1	2	1	1	1	1	1	13

Bibliography

1846 **Brulle, Auguste.** Hist. Nat. Ins. Hymenopt. p.138 (Description)

1862 **Cresson, E. T.** Ent. Soc. Phila. Proc. p.206 (Listed)

1865 —— —— 4:284 (From Colorado)

1873 —— — – Trans. 4:169 (From Texas)

1863 **Norton, Edward.** Ent. Soc. Phila. Proc. 1:358 (Specific characters)

1874 **Provancher,** *L'Abbé* **A.** Nat. Can. 6:103 (Table of species)

1879 —— —— 11:117 (Table of species), p.118 (Description)

1890 **Ashmead, W. H.** Col. Biol. Ass'n Bul. 1, p.43 (Listed)

1890 **Smith, J. B.** Cat. Ins. N. J. p.25 (Listed)

1892 **Osborn, Herbert.** Part. Cat. Animals Ia. p.15 (Listed)

1892 **Riley, C. V.** Ent. Soc. Wash. Proc. 2:134 (Parasite of Lachnosterna fusca)

1891-92 **Forbes, S. A.** Ins. Ill. 18th Rep't 1894, p.125 (Parasite of white grub)

1896 —— Ill. Agric. Exp. Sta. Bul. 44, p.272 (Same as preceding)

1894 **Slosson, A. T.** Ent. News, 5:4 (In alpine regions of Mt Washington)

Ophion nigrovarium Prov.

This species is undoubtedly closely related to the preceding form, though we have been unable to examine the original type. A few specimens from Colorado which we provisionally assigned to O. bifoveolatum, are exceptionally highly colored, and they probably belong to this species; in which event we are inclined to believe that it is but a variety of the preceding. A translation of the original description is as follows:

♂ Length .6 inch (pouce). Yellowish red varied with black. Head yellow; base and tip of the mandibles, two punctures on the top of the clypeus, the fossa at the insertion of the antennae, with the eyes are of a more or less deep brown. Eyes short, with almost no slope above. Posterior ocelli distant from each other, but close to the eyes. Antennae stout and short, brown. A puncture before the tegulae; the scutellum pale yellow. Thorax yellow; superior border of the prothorax, base of the scutellum, base of the metathorax, its sutures, upper sides of mesothorax, base of the four posterior coxae, black. Metathorax without distinct carinae. Wings slightly smoky; costal nervures brown, stigma yellow. Feet yellow, the anterior coxae in front and the posterior coxae behind more or less spotted with brown. First and second segments of abdomen brown; the posterior segment also brown on the inferior border.

♀ Of a clearer yellow than the ♂. Coxae entirely yellow, except in their articulation with the body. Base and extremity of abdomen of a deep shade of brown. Otherwise like the male. Described from two specimens. Inhabits Canada. [*Nat. Can.* 6:104]

Ophion abnormum n.sp.

A single specimen of this form was received from Colorado through the kindness of Prof. C. P. Gillette, who labeled it no. 2103. This species is very closely allied to what we have considered a light form of O. bifoveolatum Brullé.

Description. Fulvous, with indistinct ferruginous markings on the thorax and abdomen, except that the dorsum of the thorax has two distinct submedian fulvous lines and its lateral margins are also bordered by stripes of the same color. Wing spread 18 mm, length of body about 15 mm.

Head medium, face short, mandibles bidentate, tipped with dark brown or black; clypeal fossae deep, dark brown; antennae slightly shorter than the body; eyes black, small, somewhat dis-

tant from the mandibles. Ocelli glassy or black, well separated and the posterior ones distant from the eyes; thorax glassy; mesothorax convex; scutellum and postscutellum conspicuous; metathorax evenly rounded with no carinae. Wings hyaline; nervures and stigma brown, the latter with fulvous markings; cubitodiscoidal nervure plainly appendiculate, the appendix extending into the second discoidal cell; bulla of second recurrent nervure close to the cubitodiscoidal nervure, and that of the latter nearly equally distant between the appendix and the second recurrent nervure [pl. 2, fig. 5]. Legs ferruginous; claws pectinate; abdomen stout, not strongly compressed.

Described from one female from Colorado.

Ophion ferruginipennis n. sp.

One example of this unique form was in the collection of the United States National Museum and through the kind forbearance of Dr Ashmead its characterization has fallen on the writer. Another specimen was taken by Mr L. H. Joutel in the vicinity of New York city.

Description. Ferruginous; wings ferruginous and with a spread of about 40 mm; metathorax strongly areolated in much the same way as in O. t i t y r i Pack.

Head medium; mandibles bidentate; black apically; clypeal fossae deep; antennae nearly as long as the body. The fossae at their bases are well marked. Eyes large, extending nearly to the mandibles; ocelli black and the posterior pair almost contiguous to the eyes; thorax sericeous; mesothorax convex; scutellum and postscutellum prominent. Metathorax with two well developed transverse carinae and a number of longitudinal ones radiating from the insertion of the first abdominal segment. Wings subhyaline with a distinct ferruginous and, in places, fuscous tinge, specially at their base and along the anterior margins. Cubitodiscoidal vein with its appended vein stub extending one third across the cell from the well marked angle; bulla of second recurrent nervure a little distance from the cubitodiscoidal vein [pl.2, fig.1]. Legs light ferruginous, concolorous; claws pectinate; abdomen strongly compressed and somewhat darker at the tip. Length about 25mm, wing spread about 40 mm.

Described from two females. One is in the collection of the United States National Museum and the other in the New York State Museum.

Ophion costale Cresson[1]

This rare species is represented by only one individual, the type being in Mr Cresson's collection. It may be that this form is but a sport, though at present we can do no better than to allow it to stand as a distinct species.

Description. Female. "Fulvo-ferruginous, shining, face broad, the middle closely punctured, subtuberculate immediately beneath base of antennae; clypeus strongly punctured, tips truncate, lateral sutures and tips of mandibles black; cheeks swollen; antennae shorter than usual, reaching about to tip of second abdominal segment; mesothorax convex, polished; scutellum very convex; metathorax confluently punctured, without transverse carina, sutures of thorax narrowly black; wings subhyaline, stained with yellowish at base and with fuscous along apical costal margin, darkest at tip of marginal cell; basal margin of third and fourth abdominal and an oblique mark on sides of second segment, black." Length 13 mm. Habitat: Klamath county, Cal.

"Readily distinguished from all other species known to me by the ornamentation of the wings." [Cresson]

Genophion n. gen.

This genus is proposed to include certain forms remarkable for the development of the lower portions of the head, resulting in a very elongate face and considerable distance between the normal sized eye and the base of the mandible. This is specially marked in Genophion gilletti Felt, the generic type.

Table of species

a Wings fulvo-fuliginous ..... gilletti Felt
aa Wings with a distinct fulvous tinge..... coloradensis Felt

Genophion gilletti n. sp.

This small form resembles O. coloradensis Felt, but may be easily separated from it by its shorter antennae, longer face and the dark fuscous coloration of the wings. It is described from one female from Colorado, no. 2565, kindly sent me by Prof. C. P. Gillette, in whose honor it is named.

Description. Dark ferruginous, with the head and thoracic sutures black and the wings tinged with dark fuscous. Wing spread about 18 mm, length of body 9 mm.

[1]1878 Cresson, E. T. Acad. Nat. Sci. Phila. Proc. p.366.

Head large, face very long with a large, evenly rounded labrum; mandibles stout, bidentate, tipped with dark brown or black, and with black at the extreme base; clypeal fossae black and almost connected with the base of the mandibles by black impressed lines; antennae shorter than the body, stout and with the first joint of the flagellum much longer and more slender than the second; antennal fossae ringed with black and with a conspicuous, impressed, black area above; eyes rather small, distant from the base of the mandibles; ocelli glassy or black, the two lateral distant from the eyes and each connected therewith by a deep, impressed, black line. Thorax glassy with deeply impressed, jet-black sutures; mesothorax highly convex; scutellum and post-scutellum prominent; metathorax smoothly rounded and with no well developed carinae. Wings distinctly fulvo-ferruginous; cubitodiscoidal nervure uniformly arching, not appendiculate; first recurrent nervure less than one fourth the length of the second; bulla of the second recurrent nervure close to the cubito-discoidal nervure, and that of the latter distant from the second discoidal nervure by one half its length. Legs uniformly ferruginous, except the trochanter segments which are black at their base; claws pectinate; abdomen strongly compressed, first segment slender and gradually enlarging at its apical fourth.

Genophion coloradensis n. sp.

This is a small form having somewhat the general appearance of O. t i t y r i Pack., but differing from it in a number of particulars. It is described from two female specimens in the collection of the United States National Museum.

Description. Ferruginous with the thoracic sutures black, wings tinged with fulvous, wing spread 20 mm, length 9 mm.

Head medium; face long; mandibles bidentate, tipped with dark brown or black; clypeal fossae deep, dark brown; antennae about as long as the body, the fossae at their bases well marked and ringed with dark brown. Eyes medium, distant from the mandibles. Ocelli glassy or black, nearly contiguous, distant from the eyes; thorax sericeous, with black sutures; mesothorax convex; scutellum and postscutellum prominent. Metathorax with three well developed carinae, one dorsal, two lateral, radiating from the insertion of the first abdominal segment. Wings subhyaline, with a distinct fulvous tinge, specially on the hind wings. Cubitodiscoidal vein variably appendiculate (in one only a notch and in the other well marked); first recurrent nervure less than one half the length of the second; bulla of second recurrent nervure near cubitodiscoidal nervure, that of the latter at

proximal third of distance from the appendix to the second recurrent nervure. Legs light ferruginous, basal articulations variably marked with dark brown, claws pectinate. Abdomen strongly compressed, first segment slender, gradually enlarging at apical third.

Described from two females from Colorado.

INJURIOUS INSECTS

Chrysanthemum lace bug

Corythuca marmorata Uhler

Ord. Hemiptera *Family* Tingitidae

Members of this family have been characterized by Professor Comstock, in the following terms: "Dainty as fairy brides are these tiny, lace-draped insects. One glance at the fine, white meshes that cover the wings and spined thorax is sufficient to distinguish them from all other insects, for these are the only ones that are clothed from head to foot in a fine white Brussels net." This very fitting description applies to all members of the family, and where such insects are found on chrysanthemums, they are very likely to be this species. This group is not only unusual in appearance, but is also one rarely brought to the attention of the economic entomologist. This is particularly true of the species under consideration, concerning which comparatively little is known. It was described in 1878 from North Carolina but with no indication of its food habits. The next record appears in 1898 and relates to an attack the preceding year on chrysanthemums in Alabama.

This insect was brought to our notice last July by Mr Harry Blauvelt of Coeyman, who stated that it had caused considerable injury the past two or three years, and that he feared a repetition of the attack this season. His brother, Mr Egbert Blauvelt, observed that it bred abundantly on ragweed and also on some other which he was unable to identify. Specimens of the insect were colonized on potted plants and the accuracy of the complaint established beyond question. The little pests fed vigorously on the foliage, laid numerous eggs, many young developed and soon

one plant after another assumed an unhealthy appearance and died. The attack was characterized in particular by a discoloration of the leaves accompanied by a dark spotting, due to excrement, and the cast skins of the young were also abundant. The general appearance of a badly infested leaf is shown on plate 3.

Life history. The breeding of this insect was placed in Mr C. M. Walker's charge, but owing to pressure of other work he was unable to give it all the attention desirable. He learned, however, that the eggs were laid on the underside of the leaf, being thrust under the epidermis along the larger leaves and veins, leaving only the small, yellowish, conical cap in sight. The eggs soon hatch and the young develop rapidly, since between June 11 and 23 a life cycle was nearly completed. The feeding of the insect causes white, irregular blotches to appear, and if the attack is at all severe, withering of the leaves. The various molts follow each other quickly and the cast skins soon become so abundant as to give the impression of a bad infestation, whereas only a few bugs may be present. The insects are very active and pass readily from one plant to another, though none of the adults were observed to fly.

Description. This species has been the object of considerable study, and the following descriptions and the original illustrations were made under our direction by Mr C. M. Walker. It is believed that all stages are described below though they were not obtained by close breeding.

Egg [pl.4, fig.1]. Length about .5 mm, width .25 mm. Ovate, somewhat fusiform; visible tip truncate, collared, within which is a small, yellowish, ridged conical cap which is displaced by the young when it emerges.

Stage 1. Length .5 mm, breadth one third of length; antennae stout, with numerous long spines; three segmented, the terminal segment being about twice the combined length of the first and second. Legs stout, and about as long as the insect. There are simple spines arising directly from the body [pl.4, fig.2*b*], and also much shorter, compound ones originating from cone-shaped bases [pl.4, fig.2*a*]. Each abdominal segment bears on its lateral margin a single somewhat trumpet-shaped, compound spine on a conical base [pl.4, fig.3]. Two oval openings occur on the dorsal line of the posterior margin of the third and fourth abdominal segments. These may possibly be analogous to the odoriferous glands which occur in certain other species of Heteroptera.

Stage 2 [pl.4, fig.4]. Length 1 mm, width .4 mm. Form broader in proportion to length than in the first stage, and the legs are much shorter. The chief difference between this and the preceding stage, is in the size and number of spines. The dorsal, compound spines, which in stage 1 arose from conical bases, have become much thickened, taper to a point and are about one fourth the length of their bases, which latter are enormously developed and thickly studded with chitinous projections [pl.4, fig.5*a*]. The long simple spines arising directly from the body, are shorter and their bases narrow [pl.4, fig.5*b*]. The marginal, compound spines of each abdominal segment have lost all resemblance to their previous form. Their rugose, spined bases have become thickened and are about twice the length of the spine, which latter is narrowed to a sharp point.

Stage 3. Length 1 mm, width .5 mm. The terminal segment of the antenna is about two and one half times the combined length of segments 1 and 2. In this stage the compound dorsal spines mentioned in the preceding have apparently suffered little change, but their bases have increased five times the length of the spines, and are correspondingly stouter and rougher [pl.4, fig.7*a*]. The simple spines situated near these latter have not changed much, though they are somewhat longer than in stage 2 [pl.4, fig.7*b*]. The bases of the lateral abdominal, compound spines are four times the length of the spines [pl.4, fig.8*a*], which latter have not changed in appearance. Contiguous to these, singly or in pairs, are other shorter compound spines on conical projections about twice their own length [pl.4, fig.8*b*].

Stage 4 [pl.4, fig.9]. Length 1.5 mm, width .75 mm. Form ovate, tapering anteriorly. Head nearly as wide as long, obtusely rounded with the lateral margins behind the eyes arcuate, hind angles rounded. Antennae four segmented, segment 3 a little longer than the fourth, which is about equal to the combined length of 1 and 2, the last being about one half the length of the first. Rostrum stout, dark at tip and extending to about the base of the first abdominal segment. Head, bearing four groups of compound spines on tubercles or bases of varying size and length arranged as follows: a median pair at the anterior margin; three directly back of these, the central one being smaller; two groups of five of various lengths, each a little behind the eye and halfway between the median line and the lateral margin. A long simple spine is also found at the base of each of these groups.

Prothorax tapering anteriorly, three times as broad as long; with two median pairs of grouped compound spines at about equal distance from the anterior and posterior margins, the anterior pair with two smaller spines at their bases. Laterally there is a group of three compound spines at the apical angle

of the prothorax, the central one largest, and another of five at the posterior angle, three being much larger than the others. The wing pads are seen for the first time and extend to the anterior margin of the second abdominal segment. There are two sublateral groups, each consisting of two compound spines, one larger, one smaller and a simple one, near the posterior margin of the mesothorax. The anterior lateral margin is armed with a stout spine similar to that on the preceding segment, and on the posterior angle there is a group of five compound spines similar to those on the prothorax.

The abdomen consists of 10 segments, numbers 2 and 3 having a single lateral spine, while segments 4 to 8 are each ornamented with lateral groups of three compound spines [pl.4, fig.10], one being nearly twice the length of the other two. Segment 9 bears only one on each side. There is also a slender, hairlike spine of considerable length at the base of each group of spines on segments 2 to 8. Segments 2, 5, 6, 8 and 9 each bear a median pair of long, stout, compound spines [pl.4, fig.11*a*], each of which, with the exception of those on segments 2 and 9, has a simple spine at its base [pl.4, fig.11*b*]. The so called odoriferous glands appear as in the younger stages on the dorsum of the third and fourth segments. Certain extremely minute projections, with enlarged extremities are scattered over the body, arising directly from its surface. There are also more numerous chitinous points generally distributed and which give the body a brownish appearance.

Stage 5. Length about 2 mm, width nearly 1 mm. The first two segments of the antennae are about equal in length. The third is longest and not quite twice the length of the fourth [pl.4, fig.13]. The wing pads extend to the fifth segment of the abdomen, which latter is nearly fusiform, tapering anteriorly from the extremity of the wing cases. The dorsal spines are relatively much larger and more specialized and the lateral groups on the thorax and abdomen, excepting the last segment of the latter, are distinctly pediceled [pl.4, fig.12]. This is also true of the anterior median pair of the prothorax, which almost coalesce, and of the median pair of the mesothorax.

The original description of the adult is as follows: "Form similar to that of T. a r c u a t a Say. Body black, the humeral region and pleural margins sometimes paler, or piceous; the venter polished, minutely, transversely wrinkled. Bucculae highly elevated, white; antennae slender, the apical joint sometimes dusky. Pronotal vesicle high, extending far forward, regularly arching over the head, abruptly compressed anteriorly for more than half its length; the meshes large, two larger ones occupying the basal breadth; the nervures more or less em*browned,* that of the middle carinate, much elevated, entire.

Most of the nervures with short spines, which in some specimens are obsolete. Lateral lobes of pronotum short, prominent, semicircular, having the same curve anteriorly as posteriorly; narrower than the base of the hemelytra, with large, rather regular cells; the nervures of the middle tinged with brown; a brown spot exteriorly and sometimes a second spot at the posterior margin; the marginal spines long and slender. Processus divided into cells as far as the tip; only the base of the lateral margin elevated, the middle carina high, not so high as the pronotal vesicle, gradually declining to the tip, the base arched, bearing two large areoles surmounted by a series of smaller ones, the upper edge spinous. Raised margin of the sternum whitish, the metasternum circular, auriculate each side. Legs pale honey yellow, embrowned at tip and on the tarsi. Hemelytra rather quadrangular, with the basal angles very acute, very widely removed from the pronotal lateral lobes, the basal margin distinctly concave; lateral margins spinous until a little beyond the middle, the tips widened, bluntly, broadly rounded; areoles large, next to the apical series is a transverse row of three or four very large ones, usually connected with another large one in front exteriorly; vesicular elevations small, with a high carina, spinous, bearing posteriorly a brown spot; a brown spot exteriorly near the basal angle, another submarginal near the middle, and a broad brown band at tip which omits the subapical series of large areoles.

Length, 3 mm. Breadth at base of hemelytra, 1½ mm."

Remedies. This little pest being a sucking insect, can be controlled only in two ways. Clean culture will probably prove the most effective method of checking its depredations, since it would mean the destruction of weeds and various plants on which the insect could breed. There is little probability of the pest developing in large numbers if the vicinity of a chrysanthemum field is kept clear of weeds. The pest may be severely checked, if not nearly destroyed by thorough spraying with a whale oil soap solution, using 1 pound to 9 gallons of water, according to Mr Egbert Blauvelt. It is very probable that pyrethrum powder, or better still, hellebore could be used wherever a limited number of plants require treatment.

Bibliography

1878 **Uhler, P. H.** Bost. Soc. Nat. Hist. Proc. 19:415-16 (Original description)

1898 **Howard, L. O.** U. S. Dep't Agric. Div. Ent. Bul. 10, n. s. p.99 (Injuries in Alabama)

NOTES FOR THE YEAR

The season of 1903 has been marked in particular by an unusually severe outbreak of plant lice of various species, some of which continued their depredations over an abnormally extended period. These insects were so destructive and generally present on various plants in different sections, that observations relating thereto have been grouped under a separate head. Species depredating on other plants and products of value, have been grouped under convenient headings for the purpose of facilitating ready reference to the various accounts.

Plant lice

The season of 1903 may well be remembered on account of the exceeding abundance of these little insects, particularly of species of economic importance. This is an exceedingly interesting group, and their almost absolute helplessness and enormous prolificacy illustrate one of nature's provisions against the extermination of a species. Despite their apparent weakness, these little creatures are well able to hold their own, as many farmers know to their cost. This group is at present represented in America by the relatively large number of 325 species, as given by Professor Hunter in a recently issued list.

The conditions which control the abundance of these forms are not well understood, though in all probability they are largely climatic, supplemented by the beneficial work of various natural enemies. Some believe that dry weather is favorable to the increase of these little insects, and others attribute their abnormal development to a certain amount of moisture. It is very probable that a protracted dry spell, if not accompanied by excessive dust, is favorable to the development of a large number of species, and that violent rains at intervals, specially if they occur before the foliage is curled by the work of the pests, is very destructive to these little creatures. On the other hand, it is quite possible that a certain amount of moisture is desirable, and that the reports of certain persons, who have noted a coincidence between the appearance of rains and the development of these forms, may be correct.

It is undoubtedly true that natural enemies, prominent among which are ladybugs, syrphus flies and lacewing flies, serve as very useful checks on this interesting group of insects. Repeated observations in different countries, and extending over a series of years, have demonstrated that these insects multiply enormously during periods when plant lice are unusually abundant, and though it may require some time for the natural enemies to overtake their hosts, this is bound to occur in course of time.

The attack of 1903 was not only characterized by excessive severity but also by an undue prolongation; and this latter may have been in part due to unusual rains, which were not favorable to the comparatively unsheltered natural enemies and hindered their gaining an ascendancy over their hosts. The explanation for this is that the plant lice, before the appearance of the rains, had ample opportunity to curl the leaves and therefore provide themselves with shelter from almost any inclement weather. These retreats afforded admirable breeding places from which the insects could emerge and attack adjacent foliage, so that the usual destructive influence of showers would be modified to a considerable extent; on the other hand, the larger predaceous enemies would hardly reap an equal benefit from this protection, and consequently would be delayed in gaining the ascendancy.

Appletree plant lice (A p h i s m a l i Linn. and others). These species commonly occur in greater or less numbers throughout the orchards of the State, and their abnormal increase depends on favorable climatic or other conditions. Such was characteristic of the spring and early summer of 1903, and as a result injuries by these species were not only much more marked than usual but also prolonged to a much later date. The worst affected trees, which were usually young, presented a very characteristic appearance, and the injury was so severe that very little growth was possible. Such a large amount of honeydew was excreted that the foliage was almost entirely blackened, and an examination of many trees showed that the growing tips were literally covered by hungry plant lice anxious to reach a tender spot. The severity of the attack began to be evident about the last of *May, and was* more so in June, continuing in July, and in

some cases at least the plant lice were extremely abundant even to the middle of August. The worse infested trees lost a considerable portion of their foliage; the development of the fruit was severely checked in some instances and many trees were seriously injured. Complaints were received from a number of correspondents in different sections of the State, and almost every observer agreed in holding plant lice responsible for severe damage. Some quince bushes in Genesee county were reported by Mr J. F. Rose as bearing a mass of black, rolled leaves the latter part of June, and the observer in Dutchess county characterized the attack as being more severe than had been known for 10 years. The conditions in the nursery were no better than in the orchard, and a correspondent reports that plant lice obliged him to keep a gang of 15 or 20 men and boys at work continuously in the nursery with a whale oil soap solution, and some other nurserymen found themselves almost unable to cope with the insects, so severe and general was the injury.

Plant lice, as is well known, must be controlled by the use of contact insecticides, the most valuable of which for present purposes are a whale oil soap solution, tobacco water and kerosene emulsion. Some growers prefer the tobacco solution to any other and attribute greater effectiveness to it, while others have obtained excellent results with a whale oil soap solution. The latter, in the case of the appletree plant louse, should be used at a strength of 1 pound to 6 gallons of water, or even 1 to 4, and in any case great care should be exercised to secure thorough treatment. The kerosene emulsion may be used in the same way as the whale oil soap solution, and in case of severe attacks the standard emulsion may be diluted with but 6 or 7 parts of water, since it is better to scorch the foliage a little than to allow many of the insects to escape.

The severe and protracted injuries by plant lice led us to experiment with whale oil soap solution, 1 pound to 4 gallons, for the purpose of testing its effectiveness on the pest and also the liability of injuring the foliage. Apple twigs covered with the insects were dipped into the solution July 28, and on the 30th it

was found that all were killed, while repeated observations up to Sep. 8 failed to reveal any injury to the leaves. We are, however, inclined to believe that it is more important to make a very thorough application than to use a strong insecticide, and would therefore emphasize the former most strongly.

Cherry plant louse (Myzus cerasi Fabr.). This common species is likewise generally distributed throughout the State, and always occurs in greater or less numbers on cherrytrees. The past season has been marked by an excessive abundance of this insect, and in some cases sweet cherrytrees have been very seriously injured. We recall, for example, certain trees in Chautauqua county, which were so badly infested, that nearly one third of the leaf-bearing portion of twigs had the foliage so badly affected that it curled, died and dropped, and after a time new leaves were developed in their place. This injury was so great that one or two trees died, probably as an indirect result of the severe drain made on their vitality. The presence of these plant lice in large numbers began to be apparent the middle of May and continued through June and even into early July. Reports of injuries were received from a number of counties in widely separated sections of the State, and were also observed by us in various localities.

Thorough spraying, as in the case of other species, is the only method of controlling this insect, and when applications are necessary they should be timely so that the insects can not curl leaves and thus obtain shelter from the spray.

Cabbage aphis (Aphis brassicae Linn.). This species is usually present in small numbers on various cruciferous plants, and only occasionally does it attract much attention on account of its abnormal abundance and consequent injury. Mr J. F. Rose of South Byron states that about the middle of August it was so abundant on early cabbages as to give them a white appearance, and Mr George S. Graves of Newport, Herkimer co., reports it as being numerous on turnips in early August. This species was observed by us in very large numbers on rape at Kinderhook the early part of the season. The insects were so abundant as to

give a whitish color to portions of the plant and rendered walking through the field extremely disagreeable.

Chaitophorus aceris. The Norway maple has enjoyed up to recent years comparative immunity from insect pests, and it was therefore a serious disappointment to its admirers when this species of plant louse injured it so seriously in the last two or three years. The damage by this species has gradually increased, and whereas in 1900 or thereabouts many of the trees had their foliage somewhat disfigured by the sooty fungus growing in the honeydew and drops of this sticky substance occasionally fell on passersby or moistened the sidewalk beneath, in 1903 some of these unfortunate trees had their foliage almost ruined by this pest. Many of the leaves were so badly curled that they presented only about one fourth of the usual surface, and this maple instead of being an object of beauty, was a monument of misery and an eyesore on the landscape. This was true not only about Albany but in various sections of the State. This plant louse can be controlled by thoroughly spraying with a contact insecticide, such as whale oil soap, taking special pains to hit the insects on the undersurface of the leaves, and it looks as though some such treatment would have to be adopted in coming years if we are to keep this shade tree in good condition. This species was the cause of more complaint and incidentally gave more employment to parties operating a spraying outfit in Troy, than even the notorious elm leaf beetle (Galerucella luteola Müll.).

Elm aphis (Callipterus ulmifolii Mon.). This delicate species occurs somewhat generally on our American elms, and occasionally becomes exceedingly injurious, as was demonstrated in 1897 and again in 1903. This little plant louse was so abundant on many trees during the past summer that the foliage became badly smeared by the honeydew, lost its color and all but failed to perform its proper functions. This condition was somewhat general in the vicinity of Albany, at Palatine Bridge in the Mohawk valley, and a similar state of affairs was *reported from* Ogdensburg, St Lawrence co. The most of the

damage appears to be inflicted in the latter part of June and during July.

Drepanosiphum acerifolii Thos. This delicate and really beautiful species when examined under a magnifying glass, is capable of causing considerable injury to various species of maple. Its work on hard maple was observed by us last July at Nassau, where it evidently caused considerable dropping of the foliage, and the young were to be found here and there along the veins on the underside of the leaves. Nearly full grown specimens are remarkable for being incrusted with a whitish secretion which nearly covers them. This species was met with by us in considerable numbers on maples at Saratoga, where it has likewise caused some dropping of the leaves and injured the foliage to a considerable extent. It was also reported by Mr George S. Graves, as being on several varieties of maple at Newport, Herkimer co., where it caused much dropping of foliage, and it was observed by Mr Young in small numbers at Poughkeepsie.

Box elder plant louse (Chaitophorus negundinis Thos.). A number of specimens of what we believe to be this species, was submitted for examination by Mr George S. Graves of Newport, Herkimer co., who stated that it was exceedingly abundant and destructive to box elder or ash-leafed maples in that vicinity. The attack was first observed in early June and continued till September, possibly later. It is probably the same species which we observed at work in large numbers the latter part of September on some box eldertrees at Nassau.

Beechtree blight (Pemphigus imbricator Fitch). This plant louse was exceedingly abundant on some beechtrees at Newport N. Y. Our correspondent, Mr George S. Graves, sent examples under date of Oct. 29, and from the appearance of the twigs we judge that the insect was present in enormous numbers, and had the attack been earlier in the season, it would undoubtedly have caused considerable injury. Mr Graves observed the habit of this species of clustering on the underside of the twigs, and adds that moderately cold weather does not seem to affect them, since an inch of snow was seen on the hillside

only a short distance away, and the temperature during the preceding two days had been quite cold.

Wooly beech aphis (Phyllaphis fagi Linn.). This insect has been unusually numerous on purple beech foliage in Washington park, where it was found in very large numbers, July 4. Its depredations on the same tree in Westchester county have also been brought to our attention.

Birch aphis (Callipterus betulaecolens Mon.). This little species is particularly injurious to the cut-leaved birch, and is occasionally very abundant. It was reported as being quite destructive at Newport, Herkimer co., by Mr George S. Graves, and evidences of its work were found by Mr Young at Poughkeepsie in the middle of July. The latter trees showed very plainly that the insect had been exceedingly abundant, since the foliage was badly discolored and well smeared with honeydew. We also observed the work of this insect in the vicinity of Albany, and specimens of very badly infested twigs were submitted for examination by Mr E. P. Van Ness of East Greenbush. In this instance, as in the preceding, the attack was a very severe one and the tree had undoubtedly suffered greatly throughout July, if not earlier in the season. Some of the leaves bore a number of pupae of the two spotted ladybug, Adalia bipunctata Linn., which had evidently fed on the plant lice, and reduced their numbers very largely.

Pemphigus popularius Fitch. This species is rarely brought to notice, though a few infested leaves of the balm of Gilead, Populus balsamiferus, were received from Lake Clear Junction through Mr C. R. Pettis. The leaves were drawn together and had much waxy matter on their surfaces, giving them the appearance of having been coated with a whitish powder. In some instances the insects formed a series of pseudogalls on the upper side of the leaves. The cavity produced by drawing the leaf together contained numerous winged plant lice, a few nymphs and many cast skins. Mr Pettis states that all the trees in the vicinity were affected by this species. Another poplar-infesting species, Chaitophorus populicola Thos., was met with in considerable numbers on the common aspen at Karner, July 24.

Fruit tree insects

Plum curculio (Conotrachelus nenuphar Herbst). This little enemy of stone fruits is prevalent to a greater or less extent in most orchards of this State, and occasionally causes considerable injury. It is remarkable for existing in some localities in such small numbers as to cause practically no damage, while in others a large proportion of the crop would be ruined unless collecting or other repressive measures were employed. Recent experiences by several growers in the State, go far toward showing that thorough and early spraying of the foliage with an arsenical poison affords considerable protection from this pest. This method is preferred by many to the more laborious one of collecting the beetles and is certainly worthy of further trial.

Diplotaxis liberta Germ. This species is rarely brought to notice on account of its depredations and the same is true of its allies. A complaint was received Sep. 24 through the commissioner of agriculture from Mr John R. Crandall of Hauppauge, who stated that this beetle had stripped all the foliage from many young peachtrees in an orchard of about 30 acres. He added that they worked at night, burying themselves in the dirt under the trees during the day, and that anywhere from 10 to 50 were found under each tree, apparently preferring Elbertas. The beetles occurred nowhere except in the peach orchard. This insect is closely related to our common May or June beetles and presumably has similar habits, the larvae probably living on grass roots and undoubtedly thriving best in light, sandy soils. Reference to literature shows that another species, D. frondicola Blanch., was recorded in 1871[1] as being very injurious in June to leaves of rose, mountain ash and wild plum in an Iowa nursery. They were about nearly a month, feeding only at night, and were considered one of the worst pests of that year. An attack similar to the one we have recorded occurred in the spring of 1888,[2] at Herndon Va. in a young orchard which had been mostly planted the preceding year. The 12-spotted Diabrotica, Diabrotica 12-punctata, was the principal depredator, though a species

[1]Kridelbaugh. Ia. State Hort. Soc. Rep't 1871. 1872. p.161.
[2]Riley-Howard. Insect Life, 1:59.

of Diplotaxis was also present in small numbers. The plums and apricots near an old melon patch where the Diabrotica had bred were soon stripped of foliage and the insects spread over nearly the entire orchard. Another species of the same genus, D. harperi Blanch., was reported May 24, 1894,[1] as injuring strawberry plants at Campbellsburg Ind. The account states that they attacked the smaller and weaker plants on a 2½ acre field and very quickly destroyed them. As many as 20 beetles or over were found at a time on a single plant. The insects appeared first in some wheat and when that became too tough migrated to the recently set strawberry field. The soil was a light, clayey loam and paris green was applied but without benefit.

These little scarabaeids are difficult insects to control and in a general way may be classed in this respect with the closely related and well known May or June beetles, Lachnosterna, and rose beetles, Macrodactylus subspinosus Fabr. Anything that tends to make the foliage distasteful to the insects, such as dusting with air-slacked lime, wood ashes, etc. has some protective value, but comparatively little benefit results from spraying with an arsenical poison. It is possible that collecting the insects by jarring into a curculio catcher might prove of some value. This would have to be done in the evening when the beetles are on the trees, and in all probability it would require considerable shaking to dislodge them. The injury to the foliage late in the fall is of comparatively little importance compared with depredations in the spring, and apparently there is a prospect of this species causing some injury at that time, in which event it would pay to go to considerable expense in collecting the beetles or employing some other means to destroy them, so as to prevent severe injury to the trees by the destruction of fruit and leaf buds early in the season.

Appletree tent caterpillar (Malacosoma americana Fabr.). This insect is more or less injurious each year, and during the present season has not been very destructive, though somewhat abundant in various localities, specially where no effort has been made to control it. The injury, as a rule, has been less than

[1]Davis. Insect Life, 7:199

in the last two or three years, except in Cattaraugus county, where this species is reported as having increased very largely in the last two or three years.

Codling moth (Carpocapsa pomonella Linn.). It is well known that the larvae of this insect pass the winter in considerable numbers under the sheltering bark of trees, and that they gnaw pupal cavities in the outer dead bark. Our attention was recently called to a somewhat anomalous situation and an examination showed that a small tree had been badly injured by borers in preceding years and that codling moth larvae, descending the tree in the fall, had entered the galleries made by the borers and in excavating pupal cavities had not refrained from eating into living tissue where they caused considerable bleeding and at first sight lead one to suspect that the injury was due to the round-headed borer. The tree in question has a trunk about 6 inches in diameter and some 12 or 15 larvae were taken from several of the cavities. Three or four of the caterpillars were found contiguous to living tissue which had been recently eaten and from which considerable sap was flowing. The borings were conspicuous and many of the pellets were saturated with exuding sap.

Pear Psylla (Psylla pyricola Forst.). The season of 1903 has been remarkable for the unusual development of plant lice, and this little jumping species is no exception to the general rule. It has been exceedingly abundant and destructive over a considerable portion of the State, and peartrees with blackened, scanty foliage or almost none at all, were common sights during the summer not only in the Hudson river valley but also in central and western New York. The injury was much more general and severe than has been observed before, and the explanation therefor is probably found in the unusually favorable climatic conditions. Evidences of great damage began to appear in June, and during July and August the affected trees presented a truly wretched sight. In some cases the injury was so severe that most of the fruit dropped. Mr H. D. Lewis of Annandale reports the crop of that section a failure, due to the work of this pest.

Early and thorough spraying with a whale oil soap solution, 1 pound to 4 gallons, has been found thoroughly effective in the hands of Mr Albert Wood of Carleton Station, who states that he has succeeded in keeping the insect well in subjection by this means. Thorough work in the early part of the season will do much toward preventing subsequent injuries, and if the necessity arises of repeating applications, much better results will be obtained if the work is done just after a rain, which serves the useful purpose of washing away the honeydew and therefore exposing the growing insects to the deleterious action of the insecticide.

San José scale (Aspidiotus perniciosus Comst.). This pernicious insect has become so abundant in some orchards in the State that its control is a serious problem, and anything bearing on its habits and disseminative powers is of interest. The latter part of the summer was marked by the development of very large numbers of insects, the breeding being so rapid that in some places the bark of entire trees was covered.

The rapidity of its spread in a locality is of great importance, and is undoubtedly influenced by a number of factors. In the first place, there is no doubt that the spread is much more rapid where the pest is allowed to breed unrestricted than in localities where such is not the case; for example, the scale has been in the large orchard of Mr W. H. Hart of Poughkeepsie for 13 years, and yet it has failed to spread to any great extent, portions being practically free from it even after the lapse of years. A close examination of the center of infestation existing at Clinton Heights shows that while the insect has been present there for about the same time there has been no extensive spread. The primary point of infestation is a little to one side of the center of an isosceles triangle, which has an altitude of ¾ mile. This is bordered on one side by a public highway and on the other by a trolly line. Several contiguous orchards lie within this area, and the pest has gradually made its way from one to the other, though the spread has by no means been rapid. Aside from the point of original infestation, the injury to the trees has not been very marked, in fact, the spread through these small orchards

has been so slow that those in the point of the triangle, less than half a mile from the original infestation, are still free from the pest. An examination of orchards just across the highway from near this center, failed to reveal any scale. It should be stated in explanation, that while the insect was allowed to breed in considerable numbers from about 1897 to 1899, since then earnest efforts have been made to keep it in check, and as a general thing, it has been controlled in a fairly satisfactory manner. It is true that there is one point of infestation a half mile southwest of the source of trouble, but investigation shows that in all probability the scale became established there by being carried on infested trees which were set in that vicinity.

Investigations and inquiries in a peach-growing section, where the scale had become established in a few places 3 or 4 years ago, reveals the fact that the pest has already obtained a foothold in some orchards from ½ mile to 2 miles or thereabouts from others, and in this instance we are inclined to believe that these colonies established at a distance are due to the fact that no very adequate control of the insect has been maintained. It may also possibly be explained in part by the fact that young scales are fully as likely to crawl on peach foliage as on that of other fruit trees, and it would therefore stand a better chance of being conveyed by insects or birds.

New York plum scale (Eulecanium juglandis Bouché). This species is well known as a very destructive form to plumtrees in western New York, where it has at times been exceedingly injurious. Our attention was called in August to a plumtree at Kinderhook N. Y., which had the undersides of its branches literally covered with full grown scale insects and a great many young were found beside the parents. The tree itself had suffered serious injury though there were no signs of any numbers of the pest on those adjacent. This insect, as is well known, can be readily controlled by spraying in the fall or early spring with a contact insecticide, such as kerosene emulsion or whale oil soap solution, and we see no reason why the lime-sulfur wash, if it is to be employed in the orchard, would not be as effica-

cious in killing this species as it is in the destruction of the San José scale.

Plum mite (Phytoptus phlaeocoptes Nal.). The presence of this little mite on plumtrees at Marlborough, was brought to our attention some years ago, and an examination the present season shows that it exists in the locality only in very small numbers, and as a consequence is hardly likely to become a pest of any importance. The owner has cut down the original tree and anticipates very little trouble in the future.

Grapevine pests

Grapevine sawfly (Blennocampa pygmaea Harr.). The larvae of this species were met with rather plentifully July 28 in the vineyard of Mr W. H. Van Benschoten, West Park N. Y. Tips of shoots, here and there, were partially defoliated, but in no instance was material injury caused. The larvae are usually rare in New York State vineyards, so far as our observations go, and in case of their appearing in very large numbers, they should be controlled by thorough spraying with an arsenical poison.

Steely flea beetle (Haltica chalybea Ill.). This pernicious Chrysomelid is well known to grape growers, and in some vineyards in the Chautauqua region it has caused considerable injury year after year; particularly is this the case with certain vineyards located well up on the hill and back from the lake. The greatest damage is done by the beetles feeding on the unfolding buds, and the best method of checking the injury is undoubtedly by very thorough spraying or even painting the unfolding foliage with a strong arsenical mixture, particularly paris green or london purple, because these substances act more quickly than does arsenate of lead.

Grapeberry moth (Polychrosis botrana Schiff.). This insect was not only destructive in Chautauqua county but developed in such large numbers in some Ohio vineyards as to destroy one third of the crop as reported by Mr T. S. Clymonts. Our experiments have shown that one thorough spraying with an arsenical poison, preferably arsenate of lead, just after blossom-

ing, will result in severely checking this pest [*see* New York State Museum Bulletin 72].

Garden insects

Asparagus beetle (Crioceris asparagi Linn.). The common asparagus beetle as recorded in our 15th report, page 540, has attained a wide distribution over the State, though our records limit it almost entirely to the lower Hudson and Mohawk river valleys and the western portion of the State in the vicinity of the lakes. We were therefore somewhat surprised to receive a communication from Mr C. L. Williams of Glens Falls, Warren co., accompanied by specimens, stating that this species had become well established in that vicinity and was known to occur in some numbers over an area several miles in extent. This is the northernmost locality known to us, for the species in New York.

Cabbage maggot (Phorbia brassicae Bouché). This little pest of the market gardener was unusually abundant and destructive this season. Its depredations on early cabbages attracted considerable attention in Genesee county, it was credited with having destroyed one fourth of the crop in St Lawrence county, and with working to some extent in Cattaraugus county and other sections of the State. The life history of this little pest may be summarized briefly as follows: the adult insects appear in the early spring, the precise time depending somewhat on climatic and other conditions. They are, however, usually abroad in time to deposit eggs around early set plants, finding some crevice in which they may creep and place their eggs close to the stem. These remain unhatched for a period variously stated as from 4 to 10 days when the young grubs issue, attack the surface of the root and rasp a burrow into its tissues. They destroy first the smaller rootlets and then begin operations on the main root. They are frequently found in slimy burrows just beneath the surface of the stem. There are usually so many maggots that all are unable to find retreats within the tissues, and consequently many of them lie near the surface, which is kept moist by the juices from the injured parts. The wilting of the plant is the most

characteristic indication of injury and on pulling it up, the remains of the roots and the whitish, slimy maggots are easily observed.

One of the best methods for protecting cabbage plants from this insect is to surround them with a tarred paper collar about 2½ inches in diameter, which is so cut as to practically encircle the stem. These are readily adjusted about the plant, easily cut and form one of the most efficient methods of preventing the parent fly from depositing its eggs.

A carbolic soap emulsion composed of 1 pound of hard soap dissolved in a gallon of water, in which 1 pint of crude carbolic acid is then poured, emulsified and diluted with 30 parts of water, is very efficient in killing the maggots about infested plants. An application should be made shortly after the plants are set out, and repeated once a week or 10 days till after the middle of May. The standard kerosene emulsion diluted with 12 to 15 parts of water has also proved very successful. Either may be readily applied with a knapsack pump. It is possible to check the attack, where labor is cheap by removing the earth from the affected parts in the morning of a bright day and replacing it at night. The drying kills the maggots without injury to the plants. This is practised to some extent on Long Island, as stated by Mr F. A. Sirrine.

Onion maggot (Phorbia cepa rum Meigen). This serious pest of market gardeners has, like its close ally, the cabbage maggot, been very injurious in portions of the State, particularly in St Lawrence county where it is credited with having destroyed one fourth of the onion crop. It has also caused considerable complaint in the vicinity of Albany.

This insect, so far as known, has a life history very similar to that of the cabbage maggot, and may be controlled in like manner, except that it is impracticable to use the tarred paper collars though the carbolic soap wash can be employed to very good advantage.

Tarnished plant bug (Lygus pratensis Linn.). This notorious and almost ubiquitous pest occurs on a great many

plants and causes more or less injury from year to year. Last July our attention was again called to it on account of its sucking the juices from tender aster shoots and thereby killing them. Mr Egbert Blauvelt of Coeyman, who made the complaint, states that the insects can be killed by thoroughly spraying with a whale oil soap solution, using 1 pound to 9 gallons of water. Clean culture, not only in the garden but in adjacent fields, will do considerable toward reducing the numbers of this pest.

Grain and house pests

Saw-toothed grain beetle (Silvanus surinamensis Linn.). This little grain beetle is a common species in prepared foods and various grains and though occasionally very abundant, it does not as a rule cause much annoyance in this country. This species was found last August literally overrunning a dwelling house in Albany. The beetles were so numerous that they made their way into everything and the housekeeper could sweep up nearly a pint almost every warm day. They were found in all parts of the dwelling, resting on ceilings, crawling on walls, under mats, tablecloths etc. and even invaded wearing apparel, articles of food, etc. Investigation showed that the source of the trouble was several thousand bushels of oats in the bin of a near-by brewery. The insects were breeding there very rapidly and on warm days appeared in large numbers and invaded near-by dwellings. The best remedy for such an outbreak is fumigation of the grain with carbon bisulfid and similar treatment of the dwelling houses or better still fumigating them with hydrocyanic acid gas. This latter, however, is a very dangerous poison and must be handed with extreme care.

Fleas. The cat and dog flea (Ceratopsyllus serraticeps Gerv.) is a well known pest of domestic animals, and in the public mind is associated only with these animals. There are a number of records of this species propagating to a marvelous extent in houses closed for the summer, and the occupants on opening them in the fall would find their premises literally overrun by these annoying, active and most hardy pests. This has

been the experience of several Albanians in the past summer, and the most practical way of ridding the house of these vermin is by thorough fumigation with hydrocyanic acid gas, using 1 fluid ounce of sulfuric acid diluted with 2 fluid ounces of water and 1 ounce of high grade (98%) cyanid of potassium for every 100 cubic feet of space. A preliminary fumigation using half the above amounts and continuing the treatment two hours killed practically all the Psocids in the house and many fleas, while the usual amounts with a six hour fumigation destroyed all the fleas. The acid and cyanid are among our most deadly and virulent poisons and the same is true of the generated gas. Before treating, the house should be first carefully examined and every orifice or crack which would allow the egress of air should be carefully stopped. All fluids and liquid foods should be removed from the house and arrangements made so that the building can be opened from the outside after fumigation. The gas is generated by dropping the cyanid in large earthenware vessels containing the proper amount of diluted acid. It will be found advisable to have one or two of these jars in each room or hallway, and so arrange matters that the cyanid while still in the bag, can be dropped into one vessel after the other very rapidly, or else with a series of strings, dropped into all of the vessels at once. After the charge is set off the house should be carefully guarded so that no person can enter, and if it be in contact with others in a row, those in adjacent dwellings should also be warned so that the rooms next the treated building may be well aired during the fumigation, which should last from one to several hours. The building should then be thoroughly aired by opening doors and windows from the outside, and utmost pains taken to free the house of gas before any one be allowed to enter. The airing should last at least 30 minutes, and it will be preferable to extend this time to one, two or even three hours, dependent somewhat on the size of the building and the facilities for ventilation. One treatment should be sufficient but in the case of poorly constructed houses a second fumigation may be necessary a week or 10 days later. This dangerous operation should

be attempted only by those fully conversant with the nature of the materials with which they are dealing.

Shade tree and forest insects

Elm leaf beetle (Galerucella luteola Müll.). This species has won for itself a very bad reputation in the Hudson river valley on account of its extensive injuries to elms, particularly the European species. It is still extending the area of its operation. Last year it was detected in a limited portion of Saratoga Springs, and this season we were sorry to observe that it had spread over practically the entire village and would have caused material injury to the shade trees had it not been for the systematic and continued spraying conducted by the village authorities. An examination July 16 showed that the grubs were full grown in that locality and that many had pupated. We are inclined to believe that the second brood, if any, would be very limited in that section. This species has also been reported as present in very large numbers at Schuylerville, only a short distance from Saratoga Springs. It has become established over a considerable portion of Schenectady, where it is causing considerable injury and is likely to inflict more in the next year or two unless adequate measures are taken for its suppression. This insect as noted in Museum bulletin 64, has obtained a foothold at Ithaca N. Y. and we are in hopes that it will not be allowed to inflict serious injury on the beautiful trees of that city as it has on those of some others in the State. A detailed account of this species appears in Museum bulletin 57.

White marked tussock moth (Notolophus leucostigma Abb. & Sm.). This common enemy of shade trees annually attracts more or less attention on account of its ravages in different cities of the State, in spite of the fact that it is a comparatively easy one to control, not only on account of its eggs being deposited in conspicuous masses which may readily be removed from trees, but also because it is easily destroyed with arsenical poisons. In our preceding report we chronicled the abundance of this insect in Buffalo, and the present season has

been marked by a repetition of the injury, though the attack was not so severe as that of the preceding summer. The causes for this latter condition may be in part due to repressive measures adopted by citizens of that city, but on the whole we are inclined to believe that natural enemies or unfavorable climatic conditions were the most potent factors in reducing the numbers of this pest. The condition of the trees in that city is a most effective argument in favor of establishing a paid forester or other official whose duty it shall be to look after the street trees as well as those in the parks and see that they are adequately protected from insect ravages. This matter is one of increasing importance, as our cities are growing rapidly in size, and as a consequence there is a greater massing of foliage and therefore more favorable conditions for the development of large numbers of a species. It requires but a few years for insects to destroy a tree which may have been from 10 to 50 or more years in growing, and in cities where this is allowed a deterioration of real estate values must follow, accompanied by an increase of various diseases and a higher mortality, because of the rapid and extreme temperature changes due to the absence of trees.

This pest can be easily controlled in either one of two ways. Many of the caterpillars can be jarred or brushed from the infested trees, and their ascent prevented by the use of a band of loose cotton tied around the tree or a band of tar on a piece of stout paper, the latter to prevent injury to the tree. Both of these materials are very effective, and in our judgment vastly superior to the brass bands seen on the trunks of so many shade trees in Buffalo. Bands, however, are of value only in keeping the caterpillars off the trees. The jarring of the pests is somewhat laborious, and as the insects are readily detroyed by spraying with an arsenical poison a prompt application of some such material to the foliage is advisable. Arsenate of lead is one of the best poisons. It may be applied at the rate of 4 pounds to 50 gallons of water. Use this insecticide only in the prepared paste form, diluting to the proper extent, and under no conditions purchase the crystalline article. The older standard

poisons, paris green, london purple and similar preparations are very effective, though subject to washing by rains. These latter substances should be used at the rate of 1 pound to 100 gallons of water, with 1 pound of recently slaked lime to protect the foliage from burning. Spray thoroughly in any event and aim to cover so far as possible every leaf with the poison. Protective measures should be adopted early or the injury will be beyond repair. It is hardly necessary to add that it is impossible to grow magnificent trees if they are defoliated year after year, as unhappily seems to be the case in some cities in recent years.

Fall webworm (Hyphantria textor Harr.). This species appeared rather early in the season on various forest and fruit trees in different sections of the State, and in certain localities was somewhat abundant and destructive. Generally speaking it has not caused serious injury except in a few localities where no effort was made to check it. This species, like the two tent caterpillars, is readily controlled by spraying with an arsenical poison, and its conspicuous web nests, which serve as a retreat for the caterpillars, are easily removed from the tree and the inmates destroyed by crushing or burning.

Forest tent caterpillar (Malacosoma disstria Hübn.). As noted in our preceding report, Museum bulletin 64, page 104, the ravages of this pest are on the decrease, and the present season has witnessed practically no injury by this insect. A few caterpillars were observed in Rensselaer and Columbia counties but in no instance coming to our notice was a tree even partially defoliated. A lack of reports from other sections of the State indicates a like gratifying condition, and we are in hopes that this outbreak is practically ended and that the species will be comparatively innocuous for a number of years.

Walnut worm (Datana integerrima Grote & Rob.). The work of this insect is more or less evident each year, particularly in the western part of the State, and during the past summer our attention has been called to its ravages in Herkimer county, and we have observed a number of black walnut trees in Chautauqua county which have been from one half to two thirds or entirely defoliated by this caterpillar.

Beneficial insects

Chinese lady beetles (Chilocorus similis Rossi). The specimens obtained from the United States Department of Agriculture through the kindness of Dr L. O. Howard, and liberated in East Greenbush in August 1902 failed to survive the winter. A second shipment of 25 was received Aug. 13, 1903, again through the generosity of Dr Howard. These specimens were set at liberty at Kinderhook N. Y. on the estate of Mr L. L. Morrell, who is a large fruit grower. The tree selected was a large appletree badly infested with San José scale, near the barn and on the edge of the old orchard, close to his young pear orchard. There is an abundance of scale on the old trees, as well as on the young, and Mr Morrell has consented to refrain from treating these, in order to give the imported beetles an opportunity to demonstrate their value.

An examination Sep. 23, 1903, of the appletree where these insects were placed last August showed that eggs had been laid and a number of young were easily found. Four adult beetles, probably descendants of those originally established and nearly 20 larvae of varying size, from very young to nearly full grown, were found in the center of the tree. This is a quite large one and is very badly infested with the scale and there is every probability that there are many more ladybugs on it and near-by trees than were discovered, though a brief search failed to reveal any on the latter. The examination was purposely limited because of the difficulty of detecting the insects and the danger of crushing them in crawling about on the limbs. It certainly looks as though this introduction had been fully as successful as that of the preceding year and it is most earnestly hoped that some will survive the winter, in which event we may be able to demonstrate the utility of this insect in our climate.

Little black lady beetle (Pentilia misella Lec.). This little lady beetle is usually found toward the end of the season in orchards infested with San José scale, and we have on several occasions recorded its presence in some numbers. Anything relating to the abundance and effectiveness of predaceous insects is of *interest, and it* is gratifying to state that in October we found this

little species, far more abundant than we had observed it before, in a badly infested peach orchard in Orange county. The little-beetles were so numerous that 20 or 25 could easily be counted on a small portion of the trunk of a peachtree, and undoubtedly some of them bore from one to several hundred of these little lady beetles. They were crawling actively over the infested tree and evidently looking here and there for insects suitable for their needs. It is a source of regret to state that in spite of the great abundance of these little lady beetles, there appears to be no very material diminution in the numbers of the scale insects, which literally swarmed on many of the trees. The worse infested ones were more attractive to the lady beetles than the others. We have yet to meet evidence showing that this species is very efficient in reducing the numbers of this scale insect.

EXPERIMENTAL WORK AGAINST SAN JOSÉ SCALE INSECT

The control of this pernicious insect is a problem of considerable importance in localities where it has become established. This work was begun by us in 1900, primarily for the purpose of testing the effectiveness and possibilities of crude oil applications. Our results show that a mechanical emulsion of this material can be used, and if great caution is exercised in its application, comparatively little or no injury follows. So many, however, have met with such ill success that we have also experimented to a considerable extent with other materials, specially since in the last year or two we have observed some evidences of injury to the bark after the application of oil. This first appears as an enlargement of the lenticels, which is evidently followed by a great increase in thickness and a very rough, unsatisfactory condition of the bark, and this has led us to question the advisability of continuing such applications year after year, and also to make further tests of materials which were free from this objection.

Early spring or winter applications

20% mechanical crude petroleum emulsion. The work with this insecticide was continued the present season in the experimental orchard, the *application* being made Mar. 3, to about 70 trees

representing a number of the more common varieties. It will be observed that the spraying was earlier than usual, and the weather conditions favorable, the day being dry with only a moderate amount of wind. This insecticide was applied as in the spring of 1902, to the following trees: numbers 15-28, 34-47, 60-74, 79-91 and 101-14; or in other words, to the western end of the experimental orchard, a map of which was published in our report for 1900. The general character of the trees and their varieties have been previously published, and may be ascertained by referring to the above publication. Tests of the mechanical dilution were made while the work was in progress with the following results: at tree 18 slightly less than 20%; at tree 39, 26%; at trees 45 and 46, 31%; at tree 84 slightly less than 20%, and at tree 101, 33% of oil. The above figures represent more variation than is desirable, and yet, so far as we were able to see, the trees suffered very little from the treatment. Inspection a few days after showed that all were well covered with oil, though in some cases where the bark was quite rough, it is probable that there were scales which escaped.

Examination of these trees the latter part of July showed that while a number of them were rather badly infested by living young, a great many were relatively free. The following were rather badly infested: trees 15, 16, 22, 38, 41-44, 73, 79, 82 and 86. The foliage on tree 101 was light in color, small in size and the growth only fair. It looked as though it had suffered some injury, and undoubtedly the petroleum had hurt the bark to some extent. This injury was also noticeable to a lesser extent on some other trees, the most common indication being much enlarged lenticels, which seemed to be followed by an excessive development of outer bark and a corresponding roughness, so that trees in this condition presented a somewhat bad appearance.

A general examination of the experimental orchard Sep. 25, showed that the section sprayed with petroleum emulsion was generally in much better condition than that treated with the lime-sulfur wash. A few of the trees in the petroleum section, notably 23, 41 and 75, were badly infested by numerous living

young which had evidently developed within the last two or three weeks.

The ultimate effect of successive applications of crude petroleum to various fruit trees is of some interest, and on this account we purposely made annual applications to certain trees, and an examination of them is not without interest, since while it shows some injury, the damage is not so serious as it first appeared. For example, tree 101, a seckel pear, was very badly infested in 1900, when it was sprayed with undiluted petroleum and seriously injured. The following year it was treated with a mechanical mixture consisting of 15% oil and a whale oil soap solution, 1 pound to 4 gallons, and in the spring of 1902 and of 1903, with 20% mechanical emulsion. The tree at the outset, as above noted, was in poor condition. It has been steadily improving, and last December had developed a large amount of new wood, and during the present season has made a fair growth, though the foliage is rather light in color and less than normal size. Tree 114, a pear of the same variety, received undiluted crude petroleum in 1900, but was not injured so seriously as 101. Each subsequent year it has been sprayed with a mechanical crude petroleum emulsion and is now in a vigorous condition and in much better state than three years ago, though the roughness of the bark on the trunk is becoming more pronounced. Tree 69, a Howell pear, was sprayed in 1900 with the whale oil soap and petroleum combination, and with mechanical petroleum emulsions the three succeeding springs, and is now in as good condition as others which have not been subjected to annual applications of oil. The same is practically true of tree 66, a Bartlett pear. Other instances might be cited, but enough has been given to show that ordinary fruit trees can stand at least four applications in successive years without much injury. The benefits resulting from this treatment in the vicinity of Albany, as compared with those accruing from the lime-sulfur combinations, were so marked that the owner has repeatedly urged us to apply the oil to the entire orchard, because the lime-sulfur wash had not proved satisfactory in controlling the scale. It is only fair to add that much better results have

been obtained with this latter insectide in some other portions of the State.

Lime-sulfur washes. Early experiments with this material were so unfavorable, that it was supposed to have no value in our eastern climate, though it had been used with great success in California. The matter was revived in later years, and recent tests have shown that under certain conditions, at least, very large proportions of the scale have been killed by the use of this insecticide. Our applications last year were somewhat unfortunate, in view of the fact that we failed to kill a satisfactory proportion of the insects, and in this respect our results were somewhat different from those obtained by other experimenters. The treatment was followed by continued heavy rains, and this, with oil from applications the preceding year may account for the noneffectiveness of the wash. Further experiments were conducted the present season for the purpose of testing the value of the preparation more thoroughly, and also for determining, if possible, the best wash to be employed. The early spring experiments were at Clinton Heights, and at Warwick. Two formulas, in particular, were tested: one which may be known as the 30-30-30 combination to 100 gallons, and the other the 40-15-20 to 60 gallons. Both gave excellent results at Warwick, where conditions were almost ideal for careful experimentation, and a modification possessing some advantages was also employed. This latter consists of 25 pounds of lime, 20 pounds of sulfur to 60 gallons of water. Unfortunately the experiments at Clinton Heights though carefully performed failed to yield the results we desired, partly on account of unfavorable conditions due to very large trees with rough bark being the only ones available. In our experimental orchard at Clinton Heights an application of lime-sulfur, using a 30-30-30 formula, was made to the same trees treated in this way the preceding year, and we regret to state that the results were not very satisfactory, though the application was more successful than that of 1902. The spraying was followed immediately by some snow and rain, and while this may have had a detrimental effect, it does not account entirely for the failure. It is possible that the extremely

rough bark on certain trees sheltered some of the scale insects from the application, and consequently it was only a short time before the trees were restocked by breeding. An interesting series of experiments was conducted at Warwick, the essential details of which are given in the table on page 156. Owing to difficulties in application etc., it was not always possible to regulate closely the period of boiling, and while our intention was to rigidly test the long and the short boil in each formula, as a matter of fact there was some variation as will be seen on consulting the table. The destruction of the scale, however, was all that could be expected, and it is very gratifying to state that Mr W. H. Hart of Poughkeepsie, whose large orchard is infested with this pest, was able by the use of a wash composed of 30 pounds of lime, 20 pounds of sulfur and 15 pounds of salt to 60 gallons of water to keep the insects in subjection in a very satisfactory manner indeed, though some of his trees were of considerable size, being 18 to 20 or more feet high. Mr Hart was careful to have the application made in the most thorough manner and he took pains to always work with the wind when spraying, and in this manner was able to obtain a maximum efficiency with a minimum amount of labor. Comparisons on trees which were sprayed on only one side gave most gratifying testimony to the efficacy of the wash, the treated portions being practically free, while the untreated were almost covered with the pest. Ben Davis seems to be much more susceptible to the scale than the Thompkins County King. Mr Hart is of the opinon that a small amount of rain, particularly a mist for a day or two immediately after spraying, is of value because it brings the caustic wash into more intimate contact with the scale. Mr L. L. Morrell of Kinderhook has also had excellent results from use of a lime-sulfur wash and the same is true of Edward Van Alstyne of the same place.

It is undoubtedly true that considerable variation is allowable without materially influencing the value of the application. A large amount of lime probably has some value because it forms a thicker coat over the branches and is therefore a more efficient mechanical barrier in preventing the establishment of young scale

Warwick experiment, applied March 25-27

Wash	COMPOSITION AND PREPARATION							PROPERTIES				Weather
	Lime	Salt	Sulfur	Resin	Copper sulfate	Water	Boil	Color	Sediment	Adhesiveness	Results	
1	30 lb	30 lb	30 lb	0	0	100 gal.	1½ hr	Dark amber	Very little	Good	Very effective, checking breeding almost entirely and probably killing most of the females	Cloudy with strong wind
2	30 lb	0	30 lb	0	3	100 gal.	1 hr	Dark amber, bluish tinge	Very little	Good		Fair, few days following
3	30 lb	0	30 lb	0	0	100 gal.	1½ hr	Dark amber	Very little	Good		
4	30 lb	0	30 lb	0	0	100 gal.	½ hr	Light orange	Little	Fair		
5	30 lb	0	30 lb	12 lb	0	100 gal.	45 min.	Dark amber	Some	Very good		
6	40 lb	15 lb	20 lb	0	0	60 gal.	1 hr	Amber	Little	Good		
7	40 lb	15 lb.	20 lb	0	0	60 gal.	35 min.	Amber	Little	Good		
8	40 lb	0	20 lb	0	0	60 gal.	1 hr	Amber	Little	Good		
9	40 lb	0	20 lb	0	0	60 gal.	½ hr	Amber	Little	Good		
10	40 lb	0	20 lb	8 lb	0	60 gal.	40 min.	Amber	Much	Good		
11	25 lb	0	20 lb	0	0	60 gal.	2 hr	Amber, greenish tinge	Some	Good		
12	25 lb	0	20 lb.	8 lb	0	60 gal.	1 hr	Amber	Much	Fair		

insects. If too much lime is used it is liable to scale off; consequently there is a limit to the amount which can be employed, and for various practical reasons we are inclined to believe that 25 pounds of lime, 20 pounds of sulfur to 60 gallons of water is a very good proportion. The lime probably aids materially in holding the sulfur and its sulfids (which latter are undoubtedly among the most valuable constituents of the wash), and thus adds to the efficiency of the insecticide by preventing to some extent leaching of its active ingredients. Our experiments fail to indicate the necessity of prolonged boiling insisted on in so many formulas. In fact, it seems as though active boiling for 30 minutes meets every requirement. A wash prepared in this manner appears to be just as effective as one which has been boiled for a much longer time. Salt increases the specific gravity of the liquid and thus undoubtedly aids in keeping the solids in suspension, but so far as chemical action and insecticidal properties are concerned, it appears to have no value, and the same is true of its effect on the adhesive qualities of the wash. So marked is this that we have omitted it from the composition of the wash because of its very problematic value. We are still of the opinion that climatic conditions have considerable influence on the effectiveness of this insecticide, and believe that it should be applied when the trees are dry or nearly so, and that, in order to obtain satisfactory results, no large amount of rain should fall within three or four days after the spraying. This insecticide gives very good results wherever it can be applied thoroughly and has the advantage of being cheaper than any other winter wash, though it is decidedly more injurious to apparatus and exceedingly disagreeable to apply.

The resin solution [*see* p. 160 for preparation] was added to several of the washes in hopes that it would materially increase their adhesiveness and likewise their insecticidal properties, because such seemed to be the case in some preliminary indoor experiments. Field tests, however, failed to indicate any great advantage resulting from the addition of this material, except perhaps in the case of rains immediately following the applica-

tion. It affected the washes by making them more or less flaky, increasing the amount of sediment, and if much more had been added it would probably have seriously affected the operation of the pump. This material, if used, must be thoroughly diluted with warm water before being added to a cooler lime-sulfur wash, or it is likely to give trouble by gumming up the apparatus.

Summary. Our experience and experimental work may be summarized briefly, as follows:

A mechanical 20% crude petroleum emulsion is a very effective insecticide, and if the pump can be relied on to deliver a constant proportion, there is very little danger of much injury from several annual early spring applications. There is, however, some doubt as to the ultimate result, and the continued use of this material causes increased thickness and roughness of the bark, if no other injury.

Early spring applications of whale oil soap solution, even if only 1¼ pounds be used to a gallon, will control the insect in a very satisfactory manner, provided the spraying is thorough. We are by no means certain that this can be done on large trees, particularly those with rough bark.

The lime-sulfur combination is steadily gaining favor in the eastern states, and under certain conditions, at least, is fully as effective in checking the scale as either crude petroleum or a whale oil soap solution. Our experiments lead us to believe that 25 pounds of lime and 20 pounds of sulfur to 60 gallons of water, are equally as effective as larger amounts, and we believe it to be an advantage to have a little more lime than sulfur. We fail to see any beneficial results from the use of salt in this combination, and therefore have omitted it; and in our experience, active boiling for 30 minutes, if the lime is slaked in hot water and the sulfur added at once, gives just as effective a wash as one which has been boiled for one and one half or two hours.

In conclusion, the experience of Mr Hart and other up to date fruit growers, has demonstrated not only the possibility but the practicability of keeping this insect in control in an ordinary commercial orchard. Our observations show beyond doubt, that

this scale insect is a very serious enemy, and unless efficient measures are promptly adopted for its suppression, very great injuries may be caused.

Summer washes

This pernicious insect breeds with such extraordinary rapidity during the summer, that ordinary applications of whale oil soap or kerosene emulsion are not entirely satisfactory, since at the strengths usually employed only the crawling young and smaller scale insects are killed. It frequently occurs that an infestation is discovered in midsummer and the owner wishes to do something at once. The unsatisfactory results with the above named washes led Mr P. L. Huested, nursery inspector of the Department of Agriculture, to experiment with a mechanical 20% crude petroleum emulsion, which was applied in July with a kerowater sprayer to peachtrees. A test of this material was made in a very badly infested orchard in the summer of 1902, and beyond causing some of the foliage to drop where it was the thickest, particularly in places where a 25% emulsion was used, as was the case in certain areas, no serious injury to the trees followed the treatment. The results were so satisfactory that the same course was pursued last summer with equally gratifying effect so far as injuring the trees was concerned, though at the time it did not appear as if the application was effective enough in killing the scale. Subsequent observations, however, have shown that it was more beneficial than at first supposed. In spite of this, we still feel some hesitancy in recommending this treatment in summer, except, perhaps, where the pest is breeding in very large numbers.

This condition of affairs led us to undertake a series of experiments for the purpose of ascertaining if it were possible to make some combination which, while not injuring the foliage, would remain on the trees and be effective for some weeks after application, and at least kill the crawling young as they came from under the protecting scales of the females. The late Professor Lowe conducted some experiments along this line, and our work has been a continuation of that with modifications. It appeared to us as though a lime-sulfur combination, possibly without boiling, could

be made of a proper strength so that it would kill a large proportion of the younger scales, and we were in hopes that it would be powerful enough to destroy individuals emerging from females several weeks after application. The basis of these experiments was a standard wash which we had used the preceding spring with very gratifying results on dormant fruit trees. This wash contained 25 pounds of lime, 20 pounds of sulfur to 60 gallons of water. It was diluted to various strengths, and an effort made to ascertain whether boiling for 15 or 30 minutes had any material effect on the efficiency of the wash. In addition, a resin solution was used, which is prepared as follows: dissolve 3 pounds of sal soda in 3 quarts of water and add thereto 4 pounds of resin and boil till dissolved. While hot, make up to 5 gallons and keep boiling till the resin is well in solution. The resin was added simply to increase the adhesiveness of the wash, in hopes that if this were done the efficiency of the combination would be materially increased. In a few instances the lime-sulfur combination was used with the bordeaux mixture for the purpose of testing the value of this combined wash. The preparation and application of the washes was the work of Assistant C. M. Walker, who is also responsible for many of the field observations. The following table gives in a summarized form the various ingredients of the different washes and their effects on trees and scale and also the conditions under which they are applied. These experiments were conducted in our experimental orchard at Clinton Heights near the western boundary of East Greenbush.

Table of summer washes

		COMPOSITION AND PREPARATION								PROPERTIES				
Series	Wash	Lime	Sulfur	Resin	Salt	Water	Boil	Bordeaux	Application	Tree	Adhesiveness	Effect on foliage	Effect on scale	Weather
1	1	25 lb	20 lb	4 lb	0	240 gal.	0	0	After 2 hr stand	Young apple	Very poor	Uninjured	Kills crawling young only	Applied June 22, fair, with heavy showers on few following days
	2	"	"	0	15 lb	"	0	0	"	"	"	"	"	
	3	"	"	4 lb	0	960 gal.	15 min.	0	"	"	"	"	"	
	4	"	"	0	0	"	"	0	"	"	"	"	"	
	5	"	"	0	0	"	30 min.	0	"	"	"	"	"	
	6	0	0	0	0	0	0	50 gal.	"	"	Fair	"	"	
	7	0	5	1	0	0	0	"	"	"	"	"	"	
	8	5 lb	5 lb	0	0	0	15 min.	"	"	"	Good	"	"	
	9	"	"	1	0	0	0	"	"	"	Fair	"	"	
2	1	25 lb	20 lb	4 lb	0	60 gal.	0	0	After 2 hr stand	Young apple	Very poor	Uninjured	Kills crawling young only	Applied July 28, fair, with continuous rains for a number of days following
	2	"	"	"	0	120 gal.	0	0	"	"	"	"	"	
	3	"	"	"	0	60 gal.	15 min.	0	"	"	Very good	"	"	
	4	"	"	"	0	120 gal.	"	0	"	"	"	"	"	
	5	"	"	"	0	240 gal.	"	0	"	"	Very poor	"	"	
	6	"	"	"	0	480 gal.	"	0	"	"	"	"	"	
										Peach		Slightly burned		

Table of summer washes (*continued*)

		COMPOSITION AND PREPARATION								PROPERTIES				
Series	Wash	Lime	Sulfur	Resin	Salt	Water	Boil	Bordeaux	Application	Tree	Adhesiveness	Effect on foliage	Effect on scale	Weather
3	1	25 lb	20 lb	4 lb	0	60 gal.	0	0	After 2 hr stand	Old apple	Very poor	Slightly burned	No scale present	Applied August 14, fair, and days immediately following. Rain Aug. 16-20
	2	"	"	"	0	120 gal.	0	0	"	"	"	"	"	
	3	"	"	"	0	60 gal.	15 min.	0	"	"	Very good	Badly burned, leaves off	"	
	4	"	"	"	0	120 gal.	"	0	"	"	"	Burned, leaves retained	"	
	5	"	"	"	0	240 gal.	"	0	"	Old apple	Very poor	Uninjured	"	
										Peach		Tips slightly burned		
	6	"	"	"	0	480 gal.	"	0	"	Old apple	"	Uninjured	"	
										Peach		Tips slightly burned		
4	1	25 lb	20 lb	4 lb	0	240 gal.	15 min.	0	Immediately	Pear	Very good	Slightly burned	75 % killed	Applied August 21, fair and immediate days
	2	"	"	"	0	"	30 min.	0	"	Peach	"	Slightly burned	15 % killed	
										Pear		Slightly burned	85 % killed	
										Peach		Slightly burned	40 % killed	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
5	1	25 lb	20 lb	4 lb	0	240 gal.	15 min.	0	Immediately	Old apple	Good	Slightly burned	85 % killed Kills crawling young only	Applied Sep. 4, fair, warm and 3 following days. Heavy rains in October
		"	"	"	0	"	"	0	After 2 hr stand	"	"	"		
	3	"	"	"	0	"	30 min.	0	Immediately	"	"	"	No scale present	
	4	"	"	"	0	"	"	0	After 2 hr stand	Pear	"	"	30 % killed Kills crawling young only	
	5	"	"	"	0	480 gal.	15 min.	0	Immediately	Plum	Fair	Very slightly burned		
	6	"	"	"	0	"	30 min.	0	"	Pear	Very good	Uninjured		
										Peach		Tips slightly burned		

Series 1. Nine different washes were applied June 22 in this series, and observations made at intervals from June 26 to Sep. 28. Very small amounts were used and the solutions allowed to stand two hours. Different results might have been secured if larger quantities had been employed and applications made at once. The spraying was done with a fine hand atomizer and treatment limited to young, badly infested appletrees which bore all stages of the scale. These trees had been set out only a few weeks and consequently made little growth, though the foliage was in fair condition. The various washes did not injure the leaves, and it will be noted that washes 1 to 5, which were either unboiled or very dilute, adhered poorly, while 6, 7 and 9 containing bordeaux were better in this respect, and 8, which was boiled and also contained bordeaux, was much better. None could be distinguished on the tree 10 days after application. All washes killed the majority of the crawling young but did not prevent the development of established scales or the growth of young appearing after treatment. There was very little appreciable difference in the various washes, and on Sep. 8 all the trees were badly infested by all stages, crawling young being specially abundant.

Series 2. Six washes were applied July 28 in this series, and observations made from July 30 to Sep. 8. The washes were prepared in substantially the same manner as indicated above, and applied to the same lot of trees with the exception of a branch of a peachtree which was sprayed with 6. The condition of the foliage and scale infestation was identical with that in series 1, and the weather conditions were similar. Apple foliage was uninjured by any of the washes, but peach leaves were slightly burned at the tips by wash 6. Washes 3 and 4 were boiled 15 minutes, were more adhesive than the others, and Aug. 10 showed good color but on Sep. 8 no trace remained. The crawling young only were killed.

Series 3. Washes in this series were applied Aug. 14 and were similar to those of series 2. Observations were made from Aug. 17 to Sep. 8, and the conditions, preparation, etc., were practi-

cally the same as in series 1. The applications were confined to portions of old appletrees except in cases of washes 5 and 6, which were also applied to peachtrees. The scale infestation was slight and the weather fair immediately following the treatment. Appletree foliage was injured by wash 3, which caused the leaves to shrivel and fall off, and 4 burned them slightly. Wash 5 burned tips of peach leaves, and 6 had the same effect. Numbers 3 and 4 adhered very well for three weeks.

Series 4. The two washes used in this experiment were applied Aug. 21 and observations made from Aug. 27 to Oct. 20. Relatively large amounts were used and the applications made immediately after preparation. The cyclone nozzle used gave a somewhat coarser spray than the atomizer employed in the first three series. Pear, plum, peach and mulberry trees were used in this experiment and most of them were badly infested. The foliage was in good condition, the weather fair and remained so for a few days following the spraying. Plum and pear leaves were injured by wash 1, particularly in the case of a pear where the treatment was specially thorough. This latter dropped its leaves, while another, which received less of the mixture, did not, though the foliage was evidently injured. Wash 2 seriously injured peach leaves and caused slight burning of plum and mulberry foliage. Wash 1 adhered very well and was present in thick layers Sep. 8 and traces of color could be detected Oct. 20. The same was true to a lesser extent of wash 2. Oct. 20, number 1 had destroyed 75% of the scale on a peartree, and the foliage was slightly burned. A number of limbs were dying on the tree, which had dropped its lower foliage and on which the scale was entirely dead. Only about 15% of the scale had been killed on the living branches. Wash 2 killed 40% of the scale on one tree and about 85% on the other, which latter was in very bad condition.

Series 5. Six washes were applied Sep. 4, and observations made at intervals from Sep. 6 to Oct. 20. Small amounts of the washes were used and the same nozzle was employed as in series 4. Apple foliage was slightly burned by washes 1, 2 and 3,

and pear leaves with wash 4. Plum foliage was injured very slightly by wash 5, and number 6 burned tips of peach leaves to a slight extent but did not injure pear foliage. Washes 1, 2, 3 and 4 adhered well, 5 and 6 more so, 6 in particular being thickly incrusted on limbs and foliage. Wash 1 killed 85% of the scale, and there was a marked contrast between sprayed and unsprayed branches. Wash 2 had no effect on the scale, while 4 killed 30%. The latter was boiled longer and this may account for its greater effectiveness. Variation in intervals between preparation and application appeared to have no effect on the adhesive or insecticidal qualities of these washes.

Summary. A mechanical 20% crude petroleum emulsion was applied in early July, two seasons in succession, to peachtrees without causing much injury beyond dropping some of the foliage where it was the thickest. It undoubtedly destroys a large amount of scale and seriously checks breeding, yet we hesitate to do more than state what it has accomplished. It is perhaps the best thing that can be used where a very bad infestation is discovered in midsummer.

A whale oil soap solution, 1 pound to 8 or 10 gallons; a kerosene emulsion (standard formula diluted with 6 to 10 parts of water), or a 15 or 20% mechanical kerosene emulsion can be used in midsummer for checking the San José scale, but none of these materials can be relied on to kill much more than the crawling young, and breeding is soon almost as bad as before the application unless treatments are frequent.

Our experiments with lime-sulfur combinations for a summer wash have not been as successful as was hoped, though 25 pounds of lime, 20 pounds of sulfur to 240 gallons of water with a 15 minute boil killed a large percentage of the scales on an old appletree in early September without materially injuring the foliage. It is barely possible that a combination of about this strength can be used with beneficial results, but nothing of the kind can be recommended till further experiments have tested its practicability.

DISEASED AND DYING TREES AND INSECT ATTACK

The connection existing between diseased and dying trees and insect depredations is not only one of interest, but also of considerable importance, since in some instances at least serious depredations have origin in a group of diseased or dying trees. It is well known for example that certain species exhibit a decided preference for trees in this condition, and when breeding therefrom in very large numbers are liable to attack healthy trees, if nothing more suitable is within reach. It is very likely for example that the more serious injuries by the elm borer, Saperda tridentata Oliv., and the elm snout beetles, Magdalis armicollis Say and M. barbita Say, begin in this manner. These three insects can at least complete their transformations in dead tissues and are known to work in those which are living, and it seems very likely that in some cases they first attack a sickly limb or tree, and then after becoming abundant are able to kill others which show no signs of lowered vitality. The same is true of certain bark borers belonging to the genus Tomicus which operate exclusively in coniferous trees. Our largest species known as the coarse-writing bark beetle, Tomicus calligraphus Germ., usually breeds abundantly in diseased bark and instances have come under our observation where this species not only ran a few galleries in living tissues, but evidently took part in a primary attack on a tree in apparently normal condition. It was assisted in this work by a smaller pine bark beetle, Tomicus pini Say, which operates in the thinner bark, about the middle portion of the trunk and on the larger limbs. This latter species very likely has more to do in killing trees than the form previously mentioned, but evidence at hand indicates that the larger as well as the smaller may have an important part in this destructive work when conditions are favorable. The destruction of trees by insects breeding from a few dying ones was well illustrated in the summers of 1900 and 1901, at which time a number of pines in the vicinity of Albany began to look unhealthy. Investigation showed that they were infested with bark borers, and later in the season

of 1900 and the following many of the borers emerged from these dying trees and entered others, in which latter they were presumably the prime cause of death. The evidence at hand leads us to believe that in this case the bark beetles were primarily attracted to certain trees because of reduced vitality, possibly as a result of the excessive drouth of the preceding year, and that all subsequent injuries were due to their abnormal abundance; since they issued from the infested trees in swarms and attacked those adjacent, and the insects breeding from the latter in turn invaded others more remote from the center of infestation. The obtaining of data along these lines is somewhat difficult, since it is dependent on favorable conditions, and the following account of observations made during the past season has an important bearing on one aspect of this subject.

Forest fires and insect attack. The annals of entomology contain very little regarding the relationship existing between forest fires and insect attack, and the extended burnings last spring in the Adirondacks, presented a most favorable opportunity for studying this question, so far as fires occurring at that time of year are concerned. The principal object was first to secure data on the rapidity with which insect injury followed fire, and second to learn if there was a connection between extended fires and serious damage by insects in adjacent forests. It is very probable that the time of year when the fire occurs, has considerable bearing on the liability of insects entering the trees and breeding in large numbers, and the same is true of the character of the fire. A forest fire which not only kills but burns trees so badly that there is a rapid drying of those standing is much less likely to be followed by insect attack than one where there is only sufficient burning at the base to kill, specially if death is not rapid. Ap. 30, May 15 and June 3 there were somewhat extensive fires in the vicinity of Big Moose, and investigations by assistant D. B. Young, July 2, showed that insect attacks had become nicely started in the burning of May 15, more advanced in that of April 30, while practically no signs of insect presence were observed in that of June 3. This would seem to indicate that the trees are not at-

tacked till from four to six weeks after the initial injury. Mr Young's investigations showed that trees entirely killed by the fire were less subject to attack than those which had been so severely scorched as to be nearly dead or in a dying condition. An examination July 3 of a large tract at Big Moose, which was burned over June 3 and was extinguished on the 18th, failed to show any insects working on these trees; in fact, within the fire zone they were scarce, only a few common moths and a lady beetle being observed; just outside this fire zone, where trees had been felled to keep the fire from spreading, a few spruce bark beetles, Polygraphus rufipennis Kirby had begun to attack the spruce. The trees were attacked in the following order: pine, spruce, tamarack, birch, hemlock, balsam, beech and maple.

Investigations by Mr Young on Aug. 12 of the area burned June 3 showed a remarkable scarcity of bark borers (scolytids) in the fire zone at Big Moose. This may possibly be explained by the fire occurring at a time when no brood of adults was able to take advantage of the favorable conditions, and it may also be that the injured trees were not attractive enough to the insects for some reason or other. In our own experience, we have come across several burnings where it would appear as though bark borers should be abundant, and yet examination has shown them to be present in very small numbers. The timber on the above mentioned area has been injured entirely by large buprestids mentioned in succeeding paragraphs, which cause comparatively little injury to the lumber. The section burned Ap. 30 was also examined, and the principal damage here had evidently been caused by the ambrosia beetles (mentioned in following paragraphs), since they operate in sapwood and produce the black pin holes which seriously affect the commercial value of lumber.

Pine. Investigations July 9 at Lake Clear Junction, where a fire occurred May 18, showed that the pine bark borer, Tomicus pini Say, was working in the living tissues of a tree which had been injured by the fire.

The work of this species should be followed soon by that of the sawyer, Monohammus confusor Kirby, or M. scutel-

latus Say, which begins its operations by depositing eggs in large slits in the bark. The grubs tunnel the inner tissues of the bark and in the course of a short time enter the sapwood and by winter probably pierce the trunk to a considerable depth, materially injuring the lumber for other purposes than firewood. Mr Young's investigations in both July and August disclosed no signs of injury by this species. Two specimens of Rhyncolus brunneus Mann. were taken by him July 9 at Lake Clear Junction from a pine injured by fire the previous year.

Spruce. This tree was first attacked by the spruce bark beetle, Polygraphus rufipennis Kirby, and the lined ambrosia beetle, Xyloterus lineatus Kirby. The former is a very common insect in the Adirondacks and undoubtedly causes a large amount of injury by killing trees, while the latter, working as it does in the sapwood and producing conspicuous black holes, seriously affects the merchantable value of considerable lumber. July 3 almost every spruce in the area burned Ap. 30 at Big Moose was attacked by these two insects, the first working near the top of the tree, while the latter operated in the lower portions of the trunk. Another ambrosia beetle, Gnathotricus materiarius Fitch, was also observed in small numbers in the base of one or two trees. On another section, where the fire occurred May 14, it was found that the spruce bark beetle, Polygraphus rufipennis Kirby, and the lined ambrosia beetle, Xyloterus lineatus Kirby, had just begun work, and a species of Chrysobothris was also met with on spruce. Burned areas in the neighborhood of Lake Placid were also visited, and it was found that on the section where a very severe fire occurred April 30, the insects began operations later than on the area burned over about the same time at Big Moose, where the fire was not so injurious to the trees. The fire at Lake Placid, occurring June 3, was less injurious than the one at Big Moose on the same date, and on July 9 the scolytids were just beginning to attack the spruce, indicating that trees which were merely scorched, but not so much as to kill them at once, are sooner attacked by insects.

Investigations of spruce Aug. 12 on the tract at Big Moose which was burned June 3 showed that trees giving no evidence of insect attack on July 3 were infested with the larvae of a buprestid, probably Chrysobothris scabripennis Lap. & Gory. This record is of interest as showing when the trees are likely to be infested by this class of borers, which operate largely in the sapwood and do not seriously affect the value of the lumber. This beetle was fairly common on standing but badly burned spruce. The buprestid showed a decided preference for larger trees, though those which were badly scorched so that the inner bark had dried were not infested. Two or three specimens of Xylotrechus undulatus Say were taken on spruce, and Phymatodes dimidiatus Kirby was also met with in sparing numbers. The bark borers noticed above had made considerable progress.

Tamarack. Investigations July 9 of a section burned May 14 at Lake Clear Junction resulted in finding a tamarack infested by a scolytid, possibly Tomicus pini Say. A specimen of Leptura, L. subhamata Rand., was also taken from a burned trunk.

Birch. The yellow birches at Big Moose on the tract burned over Ap. 30 were in early July, in many cases, slightly green at the top and were being mined by Dryocoetes eichhoffi Hopk.; specially was this the case where the trunks were scorched seriously enough to interfere with the circulation of sap. The common flat-headed borer, Chrysobothris femorata Fabr., was taken on a fallen birch. The pigeon tremex, T. columba Linn., was observed in small numbers on birch, but investigations showed that its attack was confined to more or less decayed trees. This insect was also met with under the same conditions on maple and beech trees. Birch trees were relatively free from insect attack in August, probably because the thin bark permitted rapid evaporation and the consequent drying was unfavorable for borers, through Dryocoetes had made considerable progress in the large trees.

Hemlock. The 6-spotted buprestid, Melanophila fulvoguttata Harr., was numerous at Big Moose July 3 in the

burning of Ap. 30, on large hemlocks. Though they were somewhat green, none were observed on very small dead trees. A cerambicid, Xylotrechus undulatus Say, was observed in some numbers. Examination of these trees Aug. 10 resulted in finding some infested which showed no evidence of insect attack July 3, the larvae of Melanophila fulvoguttata Harr. probably being the principal offender. This is perhaps to be explained by this buprestid being on the wing mostly during July, and consequently there would not be a serious infestation till after the adults had flown for a period.

Balsam. Investigations July 2 on an area near Big Moose, burned over Ap. 30 resulted in finding several specimens of Chrysobothris pusilla Lap. & Gory on this tree, while C. scabripennis Lap. & Gory, were fairly common on the standing but badly burned balsams. Investigations Aug. 12 showed that the balsam compared with spruce was quite exempt from attack, probably due to the thinness of the bark and consequently quick drying of the sapwood. The lined ambrosia beetle, Xyloterus lineatus Kirby, was found in small numbers in July and its operations had progressed but little in August.

Poplar. Examinations July 7 of an area near Big Moose burned over May 14 resulted in finding a large species of Xyleborus in poplar.

Conclusions. Investigations the present season have shown that, while a number of insects are liable to attack burned trees within four to six weeks after injury, no very material injury is likely to result during the summer, except possibly from the work of ambrosia beetles. The other species either confine their operations so largely to the bark or else occur in such small numbers that for the present they may be neglected. The ambrosia beetles rarely extend their operations to a greater depth than 2 or 3 inches and as a consequence a considerable proportion of the lumber will be free of injury. This would hardly prove to be the case if the trees are allowed to remain standing *a second* season, at which time they will undoubtedly offer at-

tractive shelters for a number of other borers, some of which may penetrate the wood to a considerable depth and damage it very materially for other than firewood purposes. While prompt cutting of burned timber is advised wherever practical, the evidence at hand is not sufficient to indicate any very urgent necessity of its being removed prior to the winter following the attack. The insects now in the burned trees (if the latter are allowed to remain) will probably appear another spring and be numerous enough to cause considerable damage at least to weaker trees in the vicinity of the burned areas, and their multiplication in such places may eventually lead to a considerable extension of the damage. This is particularly liable to be the case with evergreen trees, and in the vicinity of Albany we have observed several localities where bark borer attack appeared to start with one or more infested trees, and the affected area was gradually increased till a considerable number of pines were destroyed.

It is not only advisable to cut the burned trees so far as possible during the winter, but they should also be removed from the land or at least gotten into water, so that the insects now under the dead bark will be unable to emerge and continue the attack. The same end may be attained in the case of bark borers, and they are the ones most likely to injure standing trees, by peeling the bark from the logs. This will hardly be practised in this county, even if it were profitable– something requiring demonstration.

VOLUNTARY ENTOMOLOGIC SERVICE OF NEW YORK STATE

The work of the last four years has been continued and a number of valuable observations added to our previous reports. The season of 1902 was unfavorable for the development of certain forms of insect life, and the same has been true to even a more marked extent in 1903. The latter, however, will probably go down in history as a season when plant lice or aphids were abnormally abundant and injurious to a great many plants throughout the entire State. 36 voluntary observers were appointed during

the season and but 21 of them rendered reports. This is largely due to the general scarcity of forms which lend themselves readily to observation, and the depredations of plant lice are so similar that most observers were unable to report on the outbreak in a satisfactory manner. It will be noted that the following reports contain some negative statements, which are of value because they emphasize the abnormal scarcity of various species. Too much dependence can not be placed on these reports, because with some exceptions they may be called local and not representative even of the county. It will also be observed that there are a number of conflicting statements, due to the belief by some parties that dry weather is favorable to the development of plant lice, while others state most clearly that the great increase in numbers of these pests was subsequent to the rains. It may be stated that we have not enough data to explain this difference and we are content at present to give opinions as they are transmitted. The observers all agree in reporting very cold, inclement weather in the early part of the season, and this undoubtedly had considerable effect in checking the appearance or in reducing the destructiveness of some of our more common injurious species.

Albany county [E. T. Schoonmaker, Cedar Hill]—Forest tent caterpillars (Malacosoma disstria Hübn.) hatched in limited numbers Ap. 23 and apparently have not suffered by the freeze. These insects caused practically no injury later in the season and consequently no report was made regarding the same. Elm leaf beetles (Galerucella luteola Müll.) occurred in limited numbers but were not abundant enough in the country to cause material damage.

Cattaraugus county [C. E. Eldredge, Leon]—Complaint of a looper caterpillar, probably a species of canker worm, was received June 10 with the statement that they had been observed on forest trees in that vicinity for several years, and that previously they had not appeared on appletrees. These insects were so near maturity that on June 17 no specimens were to be found. A soft scale (Lecanium ? pruinosum Coq.) was taken in some numbers from a trumpet vine. The unusually cold, inclement

weather kept insects well in control, and as a consequence there was comparatively little to report from this section.—*June 10*

Cattaraugus county [F. A. Fitch, Randolph]—Appletree tent caterpillars (Malacosoma americana Fabr.) appeared the latter part of April and were very abundant in neglected orchards, increasing immensely in numbers during the last two or three years. Squash bugs (Anasa tristis DeGeer) ruined a crop of squashes in this section last year. Cabbage butterflies (Pieris rapae Linn.) appeared about the middle of May, and the same was true of May bugs, species unknown, and various mosquitos. The white grub of the May beetle has not been as destructive as in former years.—*May 18.* Potato beetles (Doryphora 10-lineata Say), grasshoppers and the plum curculio (Conotrachelus nenuphar Herbst.) made their appearance May 26. Early in June curculios were reported as being at work, potato beetles as laying eggs, and plant lice as being present on cherrytrees. The latter are the ordinary black species (Myzus cerasi Fabr.) which has been unusually destructive and injurious in various sections of the State. Squash bugs appeared June 18, horn flies (Haemotobia serrata Rob. Desv.) the second week in June, and rose beetles (Macrodactylus subspinosus Fabr.) were very abundant on some rose bushes. Potato beetles are somewhat abundant and are laying eggs on potatoes. So far this season insects appeared to be less injurious than usual, probably on account of cold rains. —*June 22.* Large, green horseflies are quite troublesome and young grasshoppers are numerous on lowlands. Insect depredations are less than usual.—*July 8.* There are few mosquitos in the village and on the farm we saw none where commonly there have been millions. Ditching the land has undoubtedly aided very much in reducing their number. Flies are also less abundant than usual.—*July 22.* The first cabbage butterfly was observed in the field Aug. 11. A single mosquito was observed recently, though none had been seen for weeks before. Cabbage maggots (Phorbia brassicae Bouché) are working to some extent on cabbage, and the same is true of the cabbage louse

(Aphis brassicae Linn.) Grasshoppers are scarce as well as most other injurious insects.—*Aug. 17*

Cayuga county [Purley Minturn, Locke]—Appletree tent caterpillars (Malacosoma americana Fabr.) were observed for the first time May 5. Farmers have begun spraying. Very few injurious insects appeared owing probably to the extremely cold and frosty nights.—*May 5.* Colorado potato beetles (Doryphora 10-lineata Say) are very plenty, and the small, black flea beetle (Crepidodera cucumeris Harr.) is at work on potatoes and also feeding on various weeds in the potato field.—*June 11*

Chemung county [M. H. Beckwith, Elmira]—Cabbage butterflies (Pieris rapae Linn.) appeared Ap. 23. The Indian Cetonia (Euphoria inda Linn.) was observed May 1, and appletree tent caterpillars (Malacosoma americana Fabr.) the 2d. The latter do not appear to be as numerous as usual at this season of the year.—*May 8.* Currant worms (Pteronus ribesii Scop.) appeared on gooseberries May 8, asparagus beetles (Crioceris asparagi Linn.) May 11 and potato beetles (Doryphora 10-lineata Say) were first observed May 16. There were at this time no depredations of special importance.—*May 25.* Plant lice have been very abundant on plum and cherry trees but since the rains they are less numerous. Potato beetles are not very abundant and their eggs are developing slowly.- *June 30.* This has been a most remarkable season for insect depredations, as there have been very few species observed during the protracted dry weather. Early in the summer plant lice were quite abundant on cherry and plum trees and threatened for a time to cause considerable injury, but the wet weather came soon enough to prevent any great damage. Currant worms were less numerous than last year and the second brood was very small. Potato beetles were less destructive than usual and occurred in very small numbers. Cutworms were quite numerous, yet they caused less damage to plants than usual. Tobacco worms (Phlegethontius 5-maculatus Hübn.) were very scarce, in fact, only two were met with

this season, though much time was spent in tobacco fields. The striped cucumber beetle (Diabrotica vittata Fabr.) and the squash bug (Anasa tristis DeGeer) have been so few in number that their attacks were not noticed. The fall webworm (Hyphantria textor Harr.) was rather more abundant than last season.—*Oct. 8*

Dutchess county [H. D. Lewis, Annandale]—Appletree tent caterpillars (Malacosoma americana Fabr.) were first observed Ap. 20, and forest tent caterpillars (Malacosoma disstria Hübn.) on the 30th. A very few bud moth larvae (Tmetocera ocellana Schiff.) were observed May 1. Cold weather has kept insects in check and no species is remarkably abundant.—*May 4.* Tent caterpillars are, so far, much less abundant than for the past five years. The weather continues cold and dry and insects and fungi are developing slowly.—*May 12.* Tent caterpillars of both species are reported as causing some injury. Plant lice (Aphis mali Fabr. and Myzus cerasi Fabr.) are exceedingly abundant on apple and cherry trees respectively.—*May 27.* The latter have appeared recently and they are the only insects which are at all abundant. The weather continues cold and dry.—*June 1.* There is a great decrease in the number of caterpillars from last year and plant lice are exceedingly abundant.—*June 15.* Plant lice are still increasing and are the only insects which are of much importance. Tent caterpillars, both species, are not nearly so abundant as in former years. The weather is very wet at present.—*June 22.* Apple plant lice are present in enormous numbers and more abundant than they have been for 10 years. There are a few cutworms but other insects are scarce. The weather continues cold and very wet.—*June 25.* A very serious attack of pear psylla (Psylla pyricola Forst.) has developed within the last 10 days, and the crop will be seriously hurt. Apple aphis is still present in very large numbers, and potato beetles (Doryphora 10-lineata Say) are remarkable for their scarcity.—*July 10.* The apple aphis and the pear psylla continued in great abundance and have inflicted very serious damage, specially the latter. The

weather has been very wet and cold since June 1, and apparently favorable for the development of the above insects. The peartrees have suffered extremely, all the young growth being killed, and they are now starting a new growth from next year's buds. This wood can not ripen and the results must be very injurious. We visited one pear orchard of 600 trees where Psyllas were still very active and attacking the new growth as fast as it appeared. The pear crop in this section is ruined.—*Aug. 10*

Erie county [J. U. Metz, Swormville]—Striped asparagus beetle (Crioceris asparagi Linn.) was observed today for the first time. We have not been able to find any of the spotted species (C. 12-punctata Linn.). Quite a little wheat is down but we have not been able to detect any work of the Hessian fly (Cecidomyia destructor Say).—*May 28.* Currant worms (Pteronus ribesii Scop.) were observed yesterday in numbers for the first time. Rose beetles (Macrodactylus subspinosus Fabr.) are exceedingly numerous and causing considerable damage. Both moth larvae (Tmetocera ocellana Schiff.) are quite numerous and causing some injury. Not a trace of Hessian fly has been observed. Many young shoots of blackberries are affected by the gouty gall beetle (Oberea bimaculata Oliv.). Potato beetles (Doryphora 10-lineata Say) are numerous on early potatoes.—*June 11.* Rose beetles are very numerous and in one instance were so abundant that some cherrytrees were literally covered with them and looked as though they had been scorched by fire; not only the foliage but also the fruit was affected, and the insects were not above eating the grass beneath the trees. Grapevines are also being injured to some extent by these pests.—*July 6*

Genesee county [J. F. Rose, South Byron]—Cabbage butterflies (Pieris rapae Linn.) were first observed May 6, and potato beetles (Doryphora 10-lineata Say) were first noticed May 7. Tent caterpillars (Malacosoma americana Fabr.) are scarce as yet. The extremely cold, inclement weather of early May has kept many insects in check.—*May 11.* Cabbage worms were first observed on plants the 22d. Asparagus

beetles (Crioceris asparagi Linn.) are plenty. There are not many potato beetles as yet. Cigar case-bearers (Coleophora fletcherella Fern.) are very numerous in some orchards. Something has happened to tent caterpillars, as they are extremely scarce; so evident is this that it is a source of common remark. There are no evidences of injury by cankerworm.—*May 25.* The cabbage root maggot (Phorbia brassicae Bouché) is unusually numerous and very destructive to early cabbages. The four-lined leaf bug (Poecilocapsus lineatus Fabr.) is quite abundant and, as usual, is indifferent as to what kind of plant it attacks, occurring with great impartiality on burdock, peppermint, sage, currant etc. Cankerworms are very scarce in this immediate vicinity, but are reported as having done considerable damage in orchards between here and Rochester. In a trip to Niagara Falls I observed several orchards between LaSalle and that place, which were brown from the work of this pest.—*June 3.* There is practically no Hessian fly (Cecidomyia destructor Say) as after inquiry at a grange meeting, only one farmer reported any, and that was in a field of late sown no. 6 white wheat. A similar inquiry regarding cankerworms and tent caterpillars resulted in statements that very few or none had been seen. There is some complaint of plant lice on plum and cherry trees. *June 15.* The black or cucumber flea beetle (Crepidodera cucumeris Harr.) is much complained of and has not only perforated potato leaves but is said to be at work on corn and beans as well as tomatoes. The striped cucumber beetle (Diabrotica vittata Fabr.) is very numerous on squash, melon and cucumber vines, nearly destroying them in some gardens. Following our severe drouth we have had three weeks of drizzling rain, and plant lice are very bad on fruit and other trees. We have never seen them on so many varieties of trees till this year. The young growth of quinces for 6 or 8 inches on each shoot is a mass of lice, and the leaves are blackened and rolled up. This plant louse outbreak has been exceedingly severe and injurious to a great many plants. There is a very general complaint among cabbage growers about the root

maggot. The cabbage plant louse (Aphis brassicae Fabr.) is also abundant, curling the leaves and turning them blue.—*June 29.* Fall webworms (Hyphantria textor Harr.) appeared July 2 and are now quite numerous. The squash bug (Anasa tristis DeGeer) has not appeared. There was a fair crop of striped cucumber beetles and they have now disappeared. Cabbages are white with cabbage aphis. This is the first time this insect has been a serious pest in this locality. Plant lice are also exceedingly abundant on fruit trees. Pear psylla (Psylla pyricola Forst.) is very abundant and seriously injuring the crop.—*July 2.* Fall webworms are unusually numerous, and potato growers have had little difficulty in controlling the potato beetle. Cabbages are very seriously affected by the aphis. Not a squash bug has been seen.—*Aug. 17*

Greene county [O. Q. Flint, Athens]—No injurious insects have been observed except tent caterpillars (Malacosoma americana Fabr.), which appeared later than usual and are much scarcer at this date than has ever been known before. The weather was extremely dry and growers are spraying pear and plum trees.—*May 20*

Herkimer county [George S. Graves, Newport]—Black butterflies (probably Euvanessa antiopa Linn.), were observed for the first time Ap. 25, and the same is true of the cabbage butterfly (Pieris rapae Linn.). Cold winds and cloudy weather seem to have delayed the appearance of insects.—*Ap. 28.* Webs of the appletree tent caterpillar (Malacosoma americana Fabr.) began to appear Ap. 30 and were by no means abundant May 6. The weather has been too cold for any rapid increase in insect life.—*May 7.* Plant lice have appeared on wild cherrytrees, and the currant worm (Pteronus ribesii Scop.) is at work, both eggs and larvae being found. No nests of tent caterpillars have been observed this week. The weather is warm and dry. *May 14.* Potato beetles (Doryphora 10 lineata Say) were observed May 16, and currant lice (Myzus ribis Fabr.) were just appearing on the leaves on the same date. *May 21.* Black flea beetles (Crepi-

dodera cucumeris Harr.) are appearing on potato leaves, and some insect is feeding quite generally on plantains, (very probably Dibolia borealis Chev.). Horn flies (Haematobia serrata Rob.-Desv.) are quite numerous on cattle. An examination shows that eggs of the currant worm are abundant. Elm foliage is full of holes, probably the work of larvae of the elm flea beetle (Disonycha triangularis Say).—*May 27.* Terminal leaves of elms are badly twisted and wrinkled by aphis attack, very probably Schizoneura americana Riley. Potato beetles are very rarely seen, though many eggs have been observed. The foliage of the few potatoes above ground is badly eaten by the black flea beetle. Nests of the appletree tent caterpillar are very scarce and with but few tenants. Currant aphis continues abundant.—*June 3.* Rose beetles (Macrodactylus subspinosus Fabr.) were observed for the first time on rosebushes June 4, and considerable damage has been inflicted. A species of plant louse (Chaitophorus negundinis Thos.) has appeared somewhat abundantly on the ash-leaf maple. Grasshoppers are becoming quite abundant in old pastures. The scarcity of potato beetles is cause for general comment, and the black flea beetles are exceedingly numerous on potato and tomato vines.—*June 10.* A few full-grown forest tent caterpillar larvae (Malacosoma disstria Hübn.) were observed. Spittle insects are uncommonly abundant on grass under a spreading shade tree. Rose beetles (Macrodactylus subspinosus Fabr.) are abundant on appletrees, on thorn apple, and very numerous on white daisy and dock. The daisy flowers are eaten off in many instances.—*June 17.* Potato beetle larvae were observed on one plant June 22, and a few striped cucumber beetles (Diabrotica vittata Harr.) were noticed on lima beans. The currant aphis (Myzus ribis Fabr.) is causing very little damage, while tomato and potato vines are considerably injured by the black flea beetle.—*June 24.* Currant leaves appear as though they had been eaten by the sawfly, though no larvae have been observed. The little plant louse (Drepanosiphum aceri-

folii Thos.) appears to be quite common on a number of varieties of maple and is causing some injury.—*July 1.* Black-headed cabbage worms (Evergestis stramenalis Hübn.) are causing some injury to turnips. Some caterpillars, probably fall webworms (Hyphantria textor Harr.) have appeared in small numbers on an appletree. Plant lice are abundant on many plants, such as apple, elm, box-elder, birch, wild cherry, burdock, pigweed and dock. Though potato beetles were never so inconspicuous, there are plenty of grubs.—*July 22.* The maple aphis (Drepanosiphum acerifolii Thos.) appears to be the cause of much premature falling of leaves, the pests being generally distributed, occurring even in the tops of trees 60 feet high. Plant lice have appeared in some numbers on red rose bushes.—*July 29.* There is apparently another brood of black-headed cabbage worms at work, if size is any indication. Plant lice (probably Aphis brassicae Linn.), are numerous on turnips. The appletree plant louse (Aphis mali Fabr.) is abundant and seriously injuring appletrees. The pests are specially abundant on new, tender shoots. Cherrytrees are very little affected, and plumtrees more so, but in the latter case black knot is also prevalent. Grasshoppers are generally scarce, though in a few localities they are abundant. Cabbage butterfly (Pieris rapae Linn.) has not been very abundant so far this season.—*Aug. 4.* A psocid (Psocus? venosus Burm.) was found in clusters of 200 or more on the trunks of maple, and a few were also observed on appletrees. In some cases the bark of the tree seemed to be whitened as though it were partially eaten, probably by the insects gnawing away the lichens and outer portions of the bark. Larvae of the elm flea beetle (Disonycha triangularis Say) are very plentiful on elmtrees near by and have severely injured the foliage.—*Aug. 12.* A small, yellowish leaf hopper (? jassid) is abundant on beans and has apparently caused considerable yellowing of the foliage. Yellow-necked appletree worm (Datana ministra Drury) is present in small numbers, and the same is also true of the fall webworm. The brown and black woolly bears (Pyrrharctia isabella

Abb. & Sm.) were unusually numerous in a timothy field.—*Aug. 12.* Plant lice are numerous on beans, and on sunflowers there is a similar species. Codling moth larvae (Carpocapsa pomonella Schiff.) have begun operations, and wormy apples are not uncommon. Plant lice continue abundant on pigweed.—*Aug. 19.* Horn flies (Haematobia serrata Rob.-Desv.) and horseflies have been very troublesome for the past two weeks. A few caterpillars of Apatela americana Harr. were observed on soft maple today. Fall webworms (Hyphantria textor Harr.) are apparently more abundant than last year, occurring in some numbers on appletrees. Hornet nests are more numerous than usual.—*Aug. 25.* Butternut trees are very badly eaten in some places by Datana integerrima Gr. & Rob. Fall webworms continue to be unusually abundant.—*Sep. 1.* Plant lice (Chaitophorus negundinis Thos.) still continues abundant on box-elder. Apples are comparatively scarce this year and appear to be wormier than ever. A few webworm nests were observed on lilac and alder today.—*Sep. 16.* Pieris larvae are injuring foliage of cultivated nasturtiums to a considerable extent.—*Oct. 1*

Onondaga county [Mrs A. M. A. Jackson, Camillus]—First nest of an appletree tent caterpillar (Malacosoma americana Fabr.) was observed Ap. 26, and the present indications are that this insect will not be as abundant as usual. There is a report that Hessian fly (Cecidomyia destructor Say) is working in some fields.—*Ap. 28.* The blue or meat fly is quite abundant about houses. Cabbage butterflies (Pieris rapae Linn.) are about, though not numerous. Spotted lady beetles occur on many weeds and plants, and though abundant do not appear to be destructive. Tent caterpillars are not numerous and are causing very little injury. Cold, inclement weather has kept caterpillars and other insects in check. Examination of one wheat field showed no Hessian fly, and growers state that thus far none has been met with.—*May 6.* Cankerworms appeared May 12 and are quite abundant and destructive. The bud moth (Tmetocera ocellana Schiff.) is at work on appletrees, though

not causing very much injury. The forest tent caterpillar (Malacosoma? disstria Hübn.) has appeared in very small numbers on chokecherry trees. The weather is dry and warm and consequently favorable to the development of insect life. Many clover leaves have small, round holes eaten in them, possibly the work of the clover leaf weevil (Phytonomus punctatus Fabr.).—*May 13.* Cankerworms are developing rapidly and have caused a great deal of injury. Ants of several species are quite abundant.—*May 20.* Red admiral butterflies (Vanessa atalanta Linn.) have appeared but are not as abundant as usual. The appletree tent caterpillar is quite scarce, only five webs or nests being observed in a 5 mile drive. Cankerworms are abundant, and while many trees have been injured to a considerable extent, none have been entirely defoliated. Potato beetles (Doryphora 10-lineata Say) have appeared and deposited some eggs. Cold weather is keeping insects in control. Green plant lice are somewhat abundant on rosebushes. Currant worms (Pteronus ribesii Scop.) are present in small numbers, though not causing much damage. Red admiral butterflies continue scarce and others are not so numerous as usual. Potato beetles and their eggs are very abundant on early potatoes. A white frost occurred May 31 and June 1, but did not seriously affect insects.—*June 1.* Plum curculios (Conotrachelus nenuphar Herbst.) have stung much fruit and considerable is dropping. Cankerworms have about all disappeared and have not caused as much injury as in former years. Many farmers think that tent caterpillars hatched during the warm days of March and were killed by the cold weather which followed, or else perished from lack of food. This hardly seems probable, as instances have been recorded where eggs of this species hatched in the fall and the caterpillars successfully survived the winter in the latitude of Missouri.—*June 10.* There are but few cocoons of the tent caterpillars, and this appears to be due in part to the continuous wet weather of 1902, when the caterpillars ate but little, were not healthy and appeared to be only partly grown at the time they spun up. A very

few Hessian flies are to be found in the "flaxseed" stage, though no complaints of their work have been received. A leaf miner, probably Pegomyia vicina Lintn., is very abundant in a large field of beets. Spittle insects are quite common in certain fields of grass. Potato beetle eggs are hatching, but the grubs do not appear to be as numerous as the old ones and are causing comparatively little damage. Black flea beetles (Crepidodera cucumeris Harr.) have caused some injury to both tomato and potato vines. Striped cucumber beetles (Diabrotica vittata Fabr.) are present on pumpkin vines but are not causing much injury. No squash bugs (Anasa tristis DeGeer) have been observed this year, though they are usually very abundant and destructive in this section. Rose beetles (Macrodactylus subspinosus Fabr.) are quite destructive to rose bushes, though late in appearing, and leaf hoppers have also caused some injury to rose bushes. Peas are more free from weevils (Bruchus pisorum Linn.) than usual, but the vines are being eaten by a green worm similar to the cabbage worm. House flies are not as abundant as usual.—*June 29*

Orange county [J. M. Dolph, Port Jervis]—A few mourning cloaks (Euvanessa antiopa Linn.) and some Colias butterflies have appeared. Many small bees are frequenting plum blossoms.—*April 23.* Plant lice (Aphis mali Fabr. and Myzus cerasi Fabr.) are very numerous, specially on apple and cherry trees and rose bushes. Tomato plants are also affected by a species of plantlouse which may be Rhopalosiphum solani Thos. In general there are fewer insects than usual, due probably to the exceedingly dry weather.—*June 2.* Potato beetles (Doryphora 10-lineata Say) have made their appearance in considerable numbers, the first abroad on May 20, and the first larvae being observed June 9. Hundreds of lady-beetles were found on a crimson rambler rose, three or four on a leaf. We have never seen them in such great numbers before. This bush had been badly infested by plant lice, and the lady beetles were undoubtedly attracted by their prey. The currant

worm (Pteronus ribesii Scop.) has caused some injury though it has not been abundant as in former years. The spiny elm caterpillars (Euvanessa antiopa Linn.) have stripped the leaves from a number of North Carolina poplars planted for shade tree purposes.—*June 11.* Striped cucumber beetles (Diabrotica vittata Fabr.) have appeared in considerable numbers. Pear and cherry slug (Eriocampoides limacina Retz.) is inflicting much injury on the foliage of peartrees. Rose beetles (Macrodactylus subspinosus Fabr.) have been specially numerous and abundant this year. The foliage of very few bushes has escaped being eaten or seriously disfigured.—*June 30*

Rockland county [S. B. Huested, Blauvelt]—Appletree tent caterpillars (Malacosoma americana Fabr.) appeared as usual but have not done as much injury as in former years. No potato beetles have appeared, while plant lice (Myzus cerasi Fabr. and M. ribis Fabr.) are unusually abundant on cherry and currant bushes. Cutworms are reported rather plenty and cedar birds have been unusually numerous on cherry trees, probably being more noticeable on account of the scarcity of fruit.—*June 7*

St Lawrence county [C. J. Locke, Ogdensburg]—June bugs and grubs were abundant May 1. 90% of the birch trees in this section are affected by a borer, possibly the bronze birch borer (Agrilus anxius Lec.), and an equal proportion of poplar trees are also injured. These latter may possibly be affected by a buprestid, though it is not improbable that considerable damage is caused by the poplar borer (Saperda calcarata Say). The gouty gall beetle (Oberea bimaculata Oliv.) is causing considerable injury in blackberry patches. Appletree borers (Saperda candida Fabr.) are abundant and infest many appletrees. Woodpeckers are at work on infested trees, and have undoubtedly destroyed many grubs.—*May 16.* Mourning cloak butterflies (Euvanessa antiopa Linn.) were first observed May 18, and cabbage butterflies (Pieris rapae Linn.) on the 22d. Currant worms (Pteronus ribesii

Scop.) put in appearance May 18, and the same is true of the appletree aphis (Aphis mali Fabr.).—*May 22.* Eggs of the potato beetle (Doryphora 10-lineata Say) were observed May 21, and shad flies or May flies, the 22d. Mosquitos were abundant on the 25th. Generally speaking, no insects are specially injurious.—*May 28.* Cucumber beetles (Diabrotica vittata Fabr.) were very numerous June 4; same was true on the 10th of strawberry weevil (?Anthonomus signatus Say) and potato beetles. White grubs are abundant and totally destroying oats.—*June 11.* Cabbage worms appeared on the 20th, and onion maggots (Phorbia ceparum Meigen) were at work the 22d. This latter insect has destroyed one fourth of the onion crop. Cabbages have likewise suffered from the maggot (Phorbia brassicae Bouché). Rose slugs were observed at work on the 23d.—*June 25.* A second brood of currant worms appeared July 1. Cabbage worms, cucumber beetles, plant lice and onion maggots are very numerous and destructive. The wet weather continues, accompanied by an increase of leaf-eating insects. The foliage of appletrees, plumtrees, maples and elms are all attacked by plant lice. Some apples are dropping and show no sign of injury except at the end of the stem, probably the work of the codling moth (Carpocapsa pomonella Schiff.).—*July 9.* Crane flies and dragon flies were numerous July 10, and a single specimen of the tomato worm (Phlegethontius 5-maculatus Haw.) was observed on the 15th. Cabbage worms, potato beetles and plant lice continue abundant and destructive. Mosquitos are abundant and rains continue. Striped cucumber beetles and plant lice are attacking vines, egg plants and wild tansy.—*July 16.* White marked tussock moths (Notolophus leucostigma Abb. & Sm.) were observed July 20, and dragon flies on the 15th. Potato beetles are abundant and plant lice very numerous, mosquitos are rare. Cool and wet weather has interfered with the successful application and efficiency of insecticides, and as a consequence caterpillars are abundant. Apples are dropping from the tree, and only about one quarter of the crop will be saved. Most of the trouble is

probably caused by the codling moth larvae.—*July 30.* Fall webworms (Hyphantria textor Harr.) appeared July 15 on plum, apple and elm trees, and a species of sawfly on asters.—*Aug. 8.* Potato beetles continue numerous and destructive. Cool, wet weather has not affected the leaf-eating caterpillars or plant lice, both of which continue abundant.—*Aug. 14*

Saratoga county [C. W. Ferris, Schuyler]—Appletree tent caterpillars (Malacosma americana Fabr.) are present in some numbers and were not injured by a frost, the mercury dropping to 24 F. on May 2.—*May 5.* Cherry aphis (Myzus cerasi Fabr.) are abundant on sweet cherries, and a green plant louse is affecting Bosc peartrees very seriously.—*July 15*

Schenectady county [Paul Roach, Quaker Street, Schenectady co.]—Appletree tent caterpillars (Malacosoma americana Fabr.) are just hatching on trees in warm situations. Their numbers are small, and but few egg clusters have been observed.—*May 1*

Schuyler county [Mrs Harriet S. Updyke, Logan]—Appletree tent caterpillars (Malacosoma americana Fabr.) appeared for the first time May 8. They have not caused as much damage as usual.—*May 20*

Ulster county [George S. Clark, Milton]—Appletree tent caterpillars (Malacosoma americana Fabr.) have been at work for two weeks and were not affected by the frost of April 12, even though they were not protected by a web.—*Ap. 23.* Tent caterpillar nests are present in large numbers except in localities where they were carefully destroyed the preceding year.—*Ap. 30.* Tent caterpillars continue to increase in size, and their nests are becoming more conspicuous. Aphis (Myzus cerasi Fabr.) are beginning to appear on cherrytrees. Currant worms (Pteronus ribesii Scop.) are abundant on bushes that were not sprayed last year, and a few occur on those that were treated.—*May 14.* There has been no increase in appletree tent caterpillars, and currant worms are few, specially on bushes that were sprayed last year. Plant lice (Myzus cerasi Fabr.) are increasing on

cherrytrees, and it is now too late to reach them because the leaves are so badly curled. Some plant lice (Aphis mali Fabr.) have developed on appletrees. The black flea beetle (Crepidodera cucumeris Harr.) is working on potato, tomato vines and eggplants. Some caterpillars, probably those of the gartered plume moth (Oxyptilus periscelidactylus Fitch) are not doing much damage.—*May 21.* Tent caterpillars are beginning to crawl, evidently preparatory to pupation, and are not more than one quarter as abundant as last year. Plant lice are numerous on cherrytrees, specially young ones. The red spider (Tetranychus telarius Linn.) is abundant on roses.—*May 28.* A few potato bugs have just appeared, and plant lice are more abundant on cherrytrees than usual. Tent caterpillars do not appear to be as energetic as usual, possibly they were weakened by the early frost. Elm leaf beetles (Galerucella luteola Müll.) are very scarce, not a sign of one could be found on a large tree which had its foliage entirely destroyed two years ago.—*June 4.* Heavy rains have washed many of the aphids from the trees. Many plant lice continue on rosebushes that have not been sprayed.—*June 12.* The recent continued rains have prevented much damage from insect pests. Squash bugs (Anasa tristis DeGeer) are abundant enough to destroy the vines unless controlled. Some pear psylla (Psylla pyricola Forst.) has appeared on the trees in various pear orchards in this vicinity.—*June 18.* Pear psylla is injuring many trees and causing much of the fruit to drop. Plant lice are abundant on both young pear and apple trees.—*July 2*

Warren county [C. L. Williams, Glens Falls]—May beetles appeared in large numbers May 9. The asparagus beetle (Crioceris asparagi Linn.) was observed in considerable numbers May 16. It has become distributed over a tract at least 8 miles long and is abundant.—*May 25.* Rose beetles (Macrodactylus subspinosus Fabr.) appeared about June 22, and the depredations of a gray cutworm attracted attention about the same time. The former are very abundant and feed on all kinds of vegetation. The zebra caterpillar (Mamestra

picta Harr.) was found at work on strawberry plants.—*June 9.* June beetles are exceedingly abundant; more so than we have known for years.—*July 3.* The stalk borer (Papaipema nitela Guen.) is at work in small numbers on various plants, and we have succeeded in detecting a parasite on the same, which proves to be a tachinid.

Wayne county [C. H. Stuart, Newark]—The first aphids were observed on roses May 5, and comparatively few plants were infested. No tent caterpillars or cankerworms have been observed, and the spotted asparagus beetle (Crioceris 12-punctata Linn.) has disappeared, though the common species (C. asparagi Linn.) is present in force. House flies are scarce and occur only on the sunny side of buildings.—*May 19.* Plant lice began to appear the latter part of May, and have been more abundant than we have ever known them to be before. They oblige us to keep a gang of 15 or 20 men and boys at work continuously in the nursery with a whale oil soap solution to keep them in check. Larvae of lady beetles are more than usually abundant and are undoubtedly doing good service. On our lawn the only trees or plants that have escaped plant lice are poppies and evergreens; everything else is literally covered with them, or at least was so a week ago. Now the lady beetles are beginning to get the upper hand of the pests.—*July 2*

Westchester county [F. R. Calkins, Ossining]—Elm leaf beetles (Galerucella luteola Müll.) appeared May 3 and have been increasing rapidly but have caused no serious damage.—*May 4.* Bumble flower beetles (Euphoria inda Fabr.) were flying about in considerable numbers. Hundreds of them were observed, though there was no evidence of material injury. Grasshoppers were first seen May 6 and have become very numerous. Striped cucumber beetles (Diabrotica vittata Fabr.) appeared in large numbers on the 8th. The first Colorado potato beetles (Doryphora 10-lineata Say) were observed on the 15th. Appletree tent caterpillars (Malacosoma americana Fabr.) are causing a great deal of injury in this section, and species of plant lice are curling the leaves of various shrubs in this vicinity.—*May* 18. The majority of elms in this

section are in very bad condition owing to the work of the elm leaf beetle. Striped cucumber beetles continue very numerous, and potato beetles have appeared in the past week in increasing numbers. It looks as though the appletree tent caterpillars had been destroyed by some climatic condition; possibly the severe rains in May and June. Since we had 31 days of rain with hardly a ray of sunshine, the webs are empty and there are no signs of cocoons. Mosquitos are somewhat scarce. The work of the pear midge (Diplosis pyrivora Riley) is very evident, and cherry borers (probably the fruit tree bark beetles Scolytus rugulosus Ratz.), have ruined some trees.—*July 13*

Westchester county [Mrs Edwin H. Mairs, Irvington-on-Hudson]—White marked tussock moth caterpillars (Notolophus leucostigma Abb. & Sm.) are injuring the foliage of a fine purple beech, which is also suffering severely from plant lice, probably the woolly beech aphis (Phyllaphis fagi Linn.). Mapletrees have dropped many leaves, probably because of plant lice injury. Very likely this is the work of Chaitophorus aceris Thos.—*June 29.* A curious worm (Seirodonta bilineata Pack.) was found feeding on foliage of purple beech. Mosquitos are more abundant than ever. Elm leaf beetle larvae (Galerucella luteola Müll.) are crawling along the trunks of infested trees, the foliage of which is turning brown. American, English, weeping and slippery elms are all attacked. Maple and beech trees are still suffering from plant lice injury. Some red bugs are present on the infested trees.—*July 12*

Wyoming county [W. H. Roeper, Wyoming]—Appletree tent caterpillars (Malacosoma americana Fabr.) were first observed May 2. They are present in small numbers, and some think this is due to the excessively cold weather.—*May 9.* Insects of various kinds are much scarcer than usual.—*May 18.* Tent caterpillars are not causing much injury though canker-worms are working to some extent. The weather continues very cold at night, and it is exceedingly dry.—*May 25.* Codling moth larvae (Carpocapsa pomonella Schiff.) are unusually abundant in this locality, and apple aphis (Aphis mali Fabr.) is very numerous and rolling the leaves to a con-

siderable extent. The injury is so severe that it would not be surprising if a considerable proportion of the foliage dropped. Potato beetles (Doryphora 10-lineata Say) are present in large numbers. Plant lice are also working on forest trees in about the same way as on fruit trees. The weather continues very dry and appears to be favorable to plant lice. The apple crop will be only about one quarter its normal size, and pears are almost a failure. Plant lice continue to be the most destructive form in this section, and the injury is so severe that some trees have half their leaves badly curled by the pests. A good rain has benefited crops very much.—*June 15.* Maple foliage is dropping to a considerable extent, probably as a result of injury by plant lice (Drepanosiphum acerifolii Thos.)—*July 3*

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the entomologist during the year 1903. 70 are given with the title,[1] place, time of publication and a summary of the contents of each. Volume and page number are separated by a colon, the first superior figure tells the column, and the second the exact place in the column in ninths; e.g. 67:974[16] means volume 67, page 974, column 1, beginning in the sixth ninth, i.e. about two thirds of the way down.

Turnips. Country Gentleman, Nov. 27, 1902, 67:974[16]

The work of the cabbage root maggot, Phorbia brassicae Bouché, in turnips is identified and remedial measures discussed.

Experimental Work in New York State against the San José Scale [Aspidiotus perniciosus Comst.] U. S. Dep't Agric. Div. Ent. Bul. 37, n.s. 1902. p.35-36

Discussion of results obtained with 20% mechanical crude petroleum emulsion and whale oil soap.

Notes for the Year in New York. U. S. Dep't Agric. Div. Ent. Bul. 37, n.s. 1902. p.102-3

Brief records of injury by grapevine root worm, Fidia viticida Walsh; grapevine leaf hopper, Typhlocyba comes var. vitis Harr.;

[1]Titles are given as published, and in some instances they have been changed or supplied by the editors of the various papers.

appletree tent caterpillar, Clisiocampa [Malacosoma] americana Fabr.; forest tent caterpillar, Clisiocampa [Malacosoma] disstria Hübn. and fall webworm, Hyphantria cunea Drury [textor Harr.].

Observations on Certain Insects Attacking Pine Trees. U. S. Dep't Agric. Div. Ent. Bul. 37, n.s. 1902. p.103-4

Records of injuries by Tomicus calligraphus Germ., T. pini Say and also of Monohammus confusor Kirby and Dendroctonus terebrans Oliv.

Potato Wireworms. Country Gentleman, Dec. 4, 1902, 57:992[13]

General remedial measures for wireworms are briefly discussed.

Crude Petroleum as an Insecticide. Soc. Promotion Agric. Sci. Proc. 23d An. Meeting 1902, p.86-95; separate p.1-10 received Dec. 24, 1902

A review of experiments with crude petroleum and summary of results in controlling San José scale, Aspidiotus perniciosus Comst.

Maggots in Mushrooms. Country Gentleman, Jan. 1, 1903, 68:6[15]

Brief account of species injuring mushrooms and remedies therefor, Phora agarici Lint. and species of Sciara being mentioned in particular.

Entomology. U. S. N. Y. Handbook 16, revised Dec. 1902, p.1-12, issued Jan. 3, 1903

Contents

	PAGE		PAGE
Definition	1	Lectures	7
Systematic entomology	1	Voluntary observers	7
Economic entomology	2	Publications	8
History of the division	3	Educational work	9
Investigations	4	List of entomologic publications	10
Collections	5		

Grapevine Root Worm [Fidia viticida Walsh]. N. Y. State Mus. Bul. 59. 1902. p.49-84, 1 col.pl. 4 halftones

Issued Jan. 5, 1903. Republished in great part in issues of *Grape Belt* [Dunkirk N. Y.] for Jan. 9, 13, 20, 27, Feb. 3, 10.

Contents

	PAGE		PAGE
Preface	49	Description	58
Introduction	51	Life history	60
Area infested	51	Habits of the beetle	61
Signs of insect's presence	52	Eggs	63
A native species	53	Habits of the larvae	66
Allies	54	Pupa	68
Present conditions in Ohio	54	Food plants	68
Early history	57	Natural enemies	69

	PAGE
Remedial measures	69
Destroying the pupae	70
Collecting beetles	71
Arsenical poisons	73
Pulverizing the soil and mounding	76
Carbon bisulfid	76
Kerosene emulsion	77
Remedial measures (*continued*)	
Crude petroleum	77
Calcium carbid	77
Recommendations	78
Bibliography	78
Explanation of plates	81
Plates 1-6	face 81
Index	82

Cucumber Beetle. Country Gentleman, Jan. 15, 1903, 68:43[24]

Remedial measures for the striped cucumber beetle, Diabrotica vittata Fabr.

Insecticides and Notes. Country Gentleman, Jan. 15, 1903, 68:47[35]

Summary of results obtained with insecticides against San José scale, Aspidiotus perniciosus Comst., and notes on the Chinese ladybug, Chilocorus similis Rossi, and the grapevine root worm, Fidia viticida Walsh.

Beware the Pea Weevil. Country Gentleman, Jan. 22, 1903, 68:63[42]

Injuries by Bruchus pisorum Linn. in Canada and means of controlling.

Legislation against Pests. Country Gentleman, Jan. 29, 1903, 68:89[25]

General discussion of the efficacy of nursery inspection work with comments on present conditions.

The San José Scale. Country Gentleman, Feb. 19, 1903, 68:158[11]

Comparative value of crude petroleum emulsion, lime, salt and sulfur mixture and whale oil soap for Aspidiotus perniciosus Comst.

Beneficial Insects. Country Gentleman, Mar. 5, 1903, 68:206[33]

General observations on the establishment of Scutellista cyanea Motsch, Novius cardinalis Mask. and Chilocorus similis Rossi in the United States.

Scale Insects. Worcester [Mass.] Evening Gazette, Mar. 12, 1903, p.1

Summary notice of scale insects with special reference to remedies for the San José scale, Aspidiotus perniciosus Comst.

Arsenate of Lead. Country Gentleman, Mar. 19, 1903, 68:252[17]

Formula and method of preparation.

Looper Caterpillar. Country Gentleman, Mar. 19, 1903, 68:252[23]

Description too brief to permit identification of the geometrid.

Grapevine Root Worm. Country Gentleman, Mar. 19, 1903, 68:255[34]

Corrects reported error and gives estimates of damage by Fidia viticida Walsh.

Recent Work with Insecticides in the East. Col. State Bd Hort. Rep't 1902. 1903. p.121-27

Brief discussion of the value of arsenate of lead, crude petroleum, the lime, salt and sulfur mixture and whale oil soap as insecticides.

Fleas. Country Gentleman, Mar. 26, 1903, 68:276[16]

Brief account of life history with various repressive measures.

Appletree Bark Louse. Country Gentleman, Mar. 26, 1903, 68:276[24]

Remedial measures for Mytilaspis pomorum Bouché [Lepidosaphes ulmi Linn.].

Insecticides and Fungicides. U. S. N. Y. Handbook 18, p.16

More important formulas recommended with general directions for use.

Pea Weevil. Country Gentleman, Ap. 2, 1903, 68:293[24]

Discussion of rise in temperature in peas infested with Bruchus pisorum Linn. and methods of controlling the pest.

San José Scale. Country Gentleman, Ap. 2, 1903, 68:300[12]

No danger of Aspidiotus perniciosus Comst. spreading from infested wood cut in early spring.

Elm Leaf Beetle. Schenectady Daily Union, Ap. 3, 1903, p.7

Nearly the same in Evening Star [Schenectady] Ap. 3, p.12.

Extracts from Museum Bulletin 57 on Galerucella luteola Müll., with special reference to local conditions.

Shade Tree Ratings. Street forestry report on the selection, planting, cultivation and care of street shade trees by Frederic Shonnard, Dep't Public Works, Yonkers, 1903

Ratings of comparative immunity from insect enemies of various shade trees.

Dust and Other Sprays. Country Gentleman, Ap. 16, 1903, 68:350[23]

Brief discussion of various insecticides with special reference to scale insects and dry or dust sprays.

Advice about Spraying. Country Gentleman, Ap. 30, 1903, 68:392[23]

General directions for spraying with references to convenient literature.

Arsenate of Lead. Country Gentleman, May 7, 1903, 68:410[35]

Its preparation from arsenic, soda and sugar of lead not advisable. Directions are given for making it.

Literature of American Economic Entomology. Am. Ass'n Eco. Ent. 15th An. Meeting, Presidential address, Washington D. C. Dec. 26, 1902. U. S. Dep't Agric. Div. Ent. Bul. 40, n.s. 1903. p.7-22

Also published separately.

After a general review with a few statistics regarding the amount of literature relating to some of the more notorious insects, the following topics were discussed: Newspaper and Minor Articles; Reports; Bulletins; Journals; General Works and Indexes.

Work and Observations in 1902. N. Y. State Fruit Growers Ass'n Rep't 1903, p.92-94. Rec'd May 15

Results obtained with crude petroleum, whale oil soap and lime, salt and sulfur against San José scale, Aspidiotus perniciosus Comst. Notes on the establishment of Chilocorus similis Rossi and work of grapevine root worm, Fidia viticida Walsh.

Elm Leaf Beetle Ravages. Argus [Albany] May 16, 1903; New York Times, May 17; Rensselaer County Standard [Hoosick Falls] May 22, 1903, p.4

Summary of injuries by Galerucella luteola Müll. in Hudson river valley.

New York Entomologic Service. Country Gentleman, May 21, 1903, 68:451[36]

Summary of reports from voluntary observers.

Diseases and Pests. N. Y. State Lib. Bul. 80. Review of Legislation 1902, p.837-38

Summary of recent laws relating to plant diseases and insect enemies.

Importance of Injurious Insects Introduced from Abroad. Soc. Promotion Agric. Sci. Proc. 24th An. Meeting 1903, p.39-48; separate, p.1-10

Summarized account of injuries with classified lists of introduced species and notes on the relative importance of various species.

New York Entomologic Service. Country Gentleman, May 28, 1903, 68:471[33]

Summaries of reports from voluntary observers.

18th Report of the State Entomologist on Injurious and Other Insects of the State of New York 1902. N. Y. State Mus. Bul. 64. 1903. p.89-193, 1 lith. 5 halftones

Issued June 2.

Contents

	PAGE
Introduction	89
General entomologic features.	89
Office work	90
Special investigations	91
Publications	91
Collections of insects	92
New quarters	93
Voluntary observers	93
Acknowledgments	93
Injurious insects	
Euproctis chrysorrhoea, brown tail moth	94
Psila rosae, carrot rust fly	99
Notes for the year	103
Fruit tree pests	104
Small fruit insects	105
Grass and grain insects	106
Shade tree insects	108
Forest insects	110
Household insects	113
Beneficial insects	114
Injurious insects from abroad	116
Injurious insects, etc. (*continued*)	
Species of primary economic importance	120
Species which may become very destructive	122
Other species	122
Experimental work against San José scale insect	126
Fall applications	126
Spring applications	131
Summary	143
Voluntary entomologic service	144
Summaries of reports	144
Faunal studies	153
Coleoptera taken at Newport, Herkimer co. N.Y.	153
List of publications of the entomologist	161
Contributions to collection	170
Explanation of plates	178
Plates 1-6	face 179
Index	181

New York Entomologic Service. Country Gentleman, June 4, 1903, 68:498[14]

Summary of reports from voluntary observers.

Remedies for Grapevine Root Worms. Grape Belt, June 16, 1903, p.2

Brief statement of remedial measures for Fidia viticida Walsh.

New York Entomologic Service. Country Gentleman, June 18, 1903, 68:530[38]

Summary of reports from voluntary observers.

Hints to Fruit Growers and Truckers. Am. Agric. June 20, 1903, 71:648[24]

Briefly discusses the grapevine root worm, Fidia viticida Walsh, injuries in Chautauqua grape belt and remedies for same, and also the plum curculio, asparagus beetles, and insect enemies of squash.

New York Entomologic Service. Country Gentleman, June 25, 1903, 68:551[12]

Summary of reports from voluntary observers.

Destroying Flies. Country Gentleman, June 25, 1903, 68:561[21]

Destructive and preventive measures for the house fly, Musca domestica Linn.

Grapevine Root Worm. Grape Belt, June 26, 1903, p.1, 6

Beetles attack best vineyards, no decided migration, figures on efficacy of destroying pupae and remarks on value of beetle catchers and arsenical poisons for Fidia viticida Walsh.

Mosquitos. N. Y. State Mus. folder. 8p.

Issued June 29, 1903.

Brief description with discussion of habits, life history, genera and species, methods of controlling and collecting.

Grapevine Root Worm. Grape Belt, June 30, 1903, p.4

Results of breeding from entire vines and efficiency of beetle catchers for Fidia viticida Walsh.

New York Entomologic Service. Country Gentleman, July 2, 1903, 68:578[33]

Summary of reports from voluntary observers.

Plant Lice. Country Gentleman, July 9, 1903, 68:590[27]

Remedial measures for plant lice on fruit trees.

Killing Ants. Country Gentleman, July 9, 1903, 68:590[32]

Method of destroying ants in nests.

Rose Beetles. Country Gentleman, July 9, 1903, 68:590[34]

Methods of destroying the beetles, Macrodactylus subspinosus Fabr.

New York Entomologic Service. Country Gentleman, July 9, 1903, 68:590[45]

Summary of reports from voluntary observers.

About Maple Tree Borers. Rome Daily Sentinel, July 10, 1903

Methods of controlling the sugar maple borer, Plagionotus speciosus Say.

Plant Lice. Country Gentleman, July 16, 1903, 68:610[27]

Comments on unusual abundance of plant lice and remedies for the same.

New York Entomologic Service. Country Gentleman, July 16, 1903, 68:610[47]

Summary of reports from voluntary observers.

Mosquitos. Sunday [Albany] Press, July 19, 1903, p.6

Reprint of portions of mosquito folder.

Spray for Potatoes. Country Gentleman, July 23, 1903, 68:630[17]

Advises arsenate of lead for potato beetles and bordeaux mixture for fungus.

New York Entomologic Service. Country Gentleman, July 23, 1903, 68:630[43]

Summary of reports from voluntary observers.

Plant Lice. Country Gentleman, July 30, 1903, 68:650[34]

Remedies for the pests.

New York Entomologic Service. Country Gentleman, July 30, 1903, 60:650[45]

Summary of reports from voluntary observers.

Forest Fires and Insect Attack. Am. Lumberman, Aug. 8, 1903, p.15

Preliminary report on investigations in burned areas in the Adirondacks.

Aquatic Nematocerous Diptera by Oskar Augustus Johannsen. Reprint from N. Y. State Mus. Bul. 68. 1903. p.328-441

Issued Aug. 11, 1903.

This paper includes a key to families of nematocerous diptera with accounts of the net-winged midges (Blepharoceridae), black flies (Simuliidae) and mosquitos (Culicidae).

Tulip Tree Scale. Country Gentleman, Aug. 20, 1903, 68:712[25]

Brief notice with remedies for Lecanium [Eulecanium] tuliperae Cook.

Summary of Root Worm Situation and Experiments. Grape Belt, Sep. 4, 1903, p.1; Jamestown Journal, Sep. 4, 1903, p.1; Country Gentleman, Sep. 24, 1903, 68:828[27]

Brief summary of observations and experimental work on Fidia viticida Walsh in 1903.

Mosquitos on High Ground. Country Gentleman, Sep. 10, 1903, 68:781[24]

Brief comments on the breeding habits and methods of controlling these insects.

Aquatic Chrysomelidae and a Table of the Families of Coleopterous Larvae by Alex. D. MacGillivray. Reprint from N. Y. State Mus. Bul. 68. 1903. p.288-331

Issued Sep. 12, 1903.

This paper includes a key to families of coleopterous larvae and a monograph of the subfamily Donaciinae, family Chrysomelidae.

Aquatic Insects of New York State. N. Y. State Mus. Bul. 68. 1903. p.199-517, 52 pl. (3 col.) by James G. Needham Ph.D., professor of biology, Lake Forest Univ.; A. D. MacGillivray Ph.D., instructor in entomology, O. A. Johannsen M.S., instructor in civil engineering, both of Cornell Univ.; and K. C. Davis Ph.D., professor of horticulture, West Virginia Univ.

Issued Sep. 28, 1903.

Contents

	PAGE		PAGE
Preface	199	Part 5 Aquatic Chrysomelidae and a Table of the Families of Coleopterous Larvae. A. D. MacGillivray	288
Part 1 Station Work of the Summer of 1901. J. G. Needham	200	Part 6 Aquatic Nematocerous Diptera. O. A. Johannsen	328
Part 2 Food of Brook Trout in Bone Pond. J. G. Needham	204	Part 7 Sialididae of North and South America. K. C. Davis.	442
Part 3 Life Histories of Odonata suborder Zygoptera. J. G. Needham	218	Explanation of plates	487
Part 4 Some New Life Histories of Diptera. J. G. Needham	279	List of text figures	490
		Plates 1-52	face 490
		Index	501

Sialididae of North and South America by K. C. Davis. Reprint from N. Y. State Mus. Bul. 68. 1903. p.441-87

Issued Sep. 30, 1903.

A systematic and biologic account of this group.

Two Tree Pests. Country Gentleman, Oct. 1, 1903, 68:852[43]

Pear psylla, Psylla pyricola Forst. probably weakened the pear trees at Hartley Hall Pa., so that they were attacked by the fruit tree bark beetle, Scolytus rugulosus Ratz. Destruction of the infested trees by fire is advisable. The maple is probably infested by Sesia acerni Clem. Preventive measures are indicated.

Chinese Lady Bugs. Country Gentleman, Oct. 8, 1903, 68:871[18]

Records establishment and breeding of Chilocorus similis Rossi at Kinderhook N. Y.

INSECT EXCHANGE

The state collection of insects contains large numbers of many local, and in some cases somewhat rare forms. This, in connection with the fact that many species are not represented, and specially in view of the economic importance of introduced insects, led us to inaugurate a system of exchanges the past summer. *Those offered* for exchange are, in every case, only such as can be

spared without detriment to the general collections, and in return it has been our desire to obtain, so far as possible, species of economic importance in other sections of this country or any other countries, specially those which might develop into injurious pests. A preliminary exchange list was sent out in the early summer, and the results have been very gratifying, since we have been able by this means, to make a number of extremely valuable additions to the state collections. This is specially true in the case of Coccidae, and was largely possible through the kindness of Prof. V. L. Kellogg of Leland Stanford Jr University, who was able to offer us some extremely desirable Californian and Japanese scale insects in exchange for some of our native forms. Another very desirable exchange was arranged with Prof. F. H. Snow of Kansas University, who sent valuable Diptera and some cotypes, all determined by the noted authority in this group, Dr S. W. Williston. The species, 418 in number, acquired in this manner are listed below.

SPECIES RECEIVED IN EXCHANGE

The source of various species listed below, is indicated by superior figures following the author of the species, as follows:

1, from Prof. C. P. Gillette, Agricultural College, Fort Collins Col.; 2, from Prof. V. L. Kellogg, Leland Stanford Jr University, California; 3, from E. M. Ehrhorn, Mountain View Cal.; 4, from Prof. F. H. Snow, University of Kansas, Lawrence Kan.; 5, from Prof. E. A. Popenoe, state entomologist, Topeka Kan.; 6, from Prof. H. Garman, Agricultural Experiment Station, Lexington Ky.; 7, from J. G. Sanders, 8, from Prof. Herbert Osborn, both of the Ohio State University, Columbus O.

Hymenoptera

Bombus separatus *Cress.*[1]
B. sylvicola *Kirby*[1]
B. putnami *Cress.*[1]
B. proximus *Cress.*[1]
B. nevadensis *Cress.*[1]
B. morrisonii *Cress.*[1]
B. mixtus *Cress.*[1]
B. juxtus *Cress.*[1]
B. flavifrons *Cress.*[1]
B. bifarius *Cress.*[1]
B. appositus *Cress.*[1]
Psithyrus insularis *Cress.*[1]
Anthopora vallorum *Ckll.*[1]
A. urbana *Cress.*[1]
A. smithii *Cress.*[1]
A. occidentalis *Cress.*[1]
Synhalonia frater *Cress.*[1]
Melissodes obliqua Say[1]

Diadasia australis *Cress.*[1]
D. diminuta *Cress.*[1]
Megachile montivaga *Cress.*[1]
M. fidelis *Cress.*[1]
Lithurgus apicalis *Cress.*[1]
Anthidium maculifrons *Smith*[1]
A. interruptum *Say*[1]
Coelioxys gilensis *Ckill.*[1]
Augochlora coloradensis *Titus*[1]
Epeolus robustus *Cress.*[1]
E. occidentalis *Cress.*[1]
E. concavus *Cress.*[1]
E. compactus *Cress.*[1]
Nomada ridingsii *Cress.*[1]
Vespa occidentalis *Cress.*[1]
Polybia flavitarsis *Sauss.*[1]
Odynerus taos *Cress.*[1]
O. foraminatus *Sauss.*[1]
Crabro 6-maculatus *Say*[1]
Philanthus flavifrons *Cress.*[1]
Eucerceris fulvipes *Cress.*[1]

Coleoptera

Hylastes longus *Lec.*[4]
Scolytus 4-dentatus *Say*[5]
Pityogenes pondrosae *Hopk.*[1]
Tomicus integer *Eich.*[1]
Calandra oryzae *Linn.*[6]
Baris strenua *Lec.*[5]
Thysanocnemis helvolus *Lec.*[5]
T. fraxini *Lec.*[5]
Anthonomus squamosus *Lec.*[1]
Tachypterus 4-gibbus *Say*[5]
Lixus macer *Lec.*[5]
Rhynchites hirtus *Fabr.*[5]
Epicauta corvina *Lec.*[5]
Crymodes discicollis *Lec.*[1]
C. exiguus[5]
Bruchus fraterculus *Horn*[1]
B. discoideus *Say*[5]
B. 4-maculatus *Fabr.*[5]
B. mimus *Say*[1]
Spermophagus robiniae *Sch.*[1]
Chelymorpha phytophagica *Cr.*[5]
Cassida pallidula *Boh.*[5]
C. ellipsis *Lec.*[5]
Diabrotica lemniscata *Lec.*[4]
Monocesta coryli *Say*[4]
Lina lapponica *Linn.*[6]
Colaspis favosa *Say*[4]
Paria viridicyanea *Cr.*[4]
Myochrous denticollis *Say*[1]
Fidia longipes *Melsh*[4]
Exema conspersa *Mann.*[4]
E. dispar *Lec.*[5]
Saxinis omogera *Lac.*[4]
Babia 4-guttata *Oliv.*[4]
Coscinoptera dominicana *Fabr.*[4]
C. axillaris *Lec.*[4]
Tetraopes canescens *Lec.*[1]
T. femoratus *Lec.*[1]
Dectes spinosus *Say*[4]
Plectrodera scalator *Fabr.*[1]
Dorcaschema alternatum *Say*[5]
D. wildii *Uhler*[5]
Monohammus oregonensis *Lec.*[1]
Monilema annulatum *Say*[5]
Leptura chrysocoma *Kirby*[1]
Typocerus sinuatus *Newm.*[5]
Neoclytus muricatulus *Kirby*[4]
Cyllene decorus *Oliv.*[4]
Tragidion fulvipenne *Say*[4]
Rhopalophora longipes *Say*[4]
Eburia 4-geminata *Say*[4]
Callidium janthinum *Lec.*[1]
Prionus imbricornis *Linn.*[5]
Euphoria kernii *Hald.*[5]
E. kernii *var.*[5]
E. kernii *black var.*[5]
E. areata *Fabr.*[5]
Dynastes tityus *Linn.*[6]
Strigoderma arboricola *Fabr.*[5]
Polyphylla decemlineata *Say*[1]
Bolboceras farctus *Fabr.*[6]
Phanaeus palliatus[1]
Canthon praticola *Lec.*[5]
Hydnocera tabida *Lec.*[4]
H. subfasciata *Lec.*[1]
Clerus sphegeus *Fabr.*[4]
C. nigriventris *Lec.*[4]
C. ichneumoneus *Fabr.*[5]
C. spinolae *Lec.*[5]
Acmaeodera pulchella *Herbst.*[1]
Psiloptera drummondi *Lap. & Gory.*[5]
Gyascutus obliteratus *Lec.*[1]
Limonius canus *Lec.*[1]
Elater apicatus *Say*[1]
Crytohypnus pectoralis *Say*
Plegaderus nitidus *Horn*[1]
Hister instratus *Lec.*[1]
Orphilus niger *Rossi*[5]

Dermestes fasciatus *Lec.*[1]
Silvanus planatus *Germ.*[1]
Languria laeta *Lec.*[1]
Hyperaspis lateralis *Muls.*[1]
Brachyacantha dentipes *Fabr.*[4]
Exochomus contristatus *Muls.*[4]
E. aethiops *Bland.*[1]
Coccinella abdominalis *Say*[4]
C. annectans *Cr.*[1]
C. monticola *Muls.*[4]
C. transversoguttata *Fabr.*[1]
Hippodamia sinuata *Muls.*[1]
Olibrus vittatus *Lec.*[1]
Homalium humerosum *Fauv.*[1]
Homalota lividipennis *Mann.*[1]
Dineutes assimilis *Aube.*[5]
Nothopus zabroides *Lec.*[1]
Cymindis planipennis *Lec.*[1]
Lebia atriceps *Lec.*[1]
Anophthalmus horni *Garman*[6]
Tetracha virginica *Linn.*[6]

Diptera

Cistogaster immaculata *Macq.*[4]
Gymnosoma fuliginosa *Desv.*[4]
Xanthomelana arcuata *Say*[4]
Hemyda aurata *Desv.*[4]
Epigrimyia lucens *Town.*[4]
Belvoisia bifasciata *Fabr.*[4]
B. unifasciata *Desv.*[4]
Ocyptera carolinae *Desv.*[4]
O. dosiades *Walk.*[4]
Linnaemyia comta *Fall.*[4]
Blepharipeza adusta *Loew.*[4]
Hilarella polita *Town.*[4]
Gonia capitata *DeG.*[4]
Spallanzania hebes *Fall.*[4]
S. hesperidarum *Will.*[4]
Tricophora ruficauda *v.d. W.*[4]
Peleteria robusta *Wied.*[4]
Archytas analis *Fabr.*[4]
A. aterrima *Desv.*[4]
A. hystrix *Wied.*[4]
A. lateralis *Macq.*[4]
Echinomyia algens *Wied.*[4]
E. decisa *Walk.*[4]
E. hystricosa *Will.*[4]
Epalpus bicolor *Will.*[4]
E. signifera *Will.*[4]
Bombyliomyia abrupta *Wied.*[4]
Dejeania vexatrix *O. S.*[4]
Paradejeania rutilioides *Jaen.*[4]
Jurinella ambigua *Macq.*[4]
Syrphus arcutatus *Fall.*[8]
S. umbellatarum *Schiner* [8]
Mesograpta marginata *Say*[8]
M. polita *Say*[8]
Rhingia nasica *Say*[8]
Heliophilus laetus *Loew.*[8]
Tropidia quadrata *Say*[8]
Spilomyia longicornis *Loew.*[8]
Chrysops callidus *O. S.*[4]
C. plangens *Wied.*[4]
Tabanus rhombicus *O. S.*[4]

LIST OF CULICIDAE FROM PROF. F. V. THEOBALD, ENGLAND

Myzomyia rossi *Giles;* India
Pyretophorus costalis *Loew;* West Africa
Myzorhynchus barbirostris *v. d. Wulp.;* Malay states
M. nigerrimus *Giles;* India
M. sinensis *Wied.;* Malay states
Nyssorhynchus fuliginosus *Giles;* India
N. jamesii *Theob.;* India
N. maculata *Theob.;* India
N. masteri *Skuse;* Australia
Cellia argyrotarsis *Desv.;* South Lucia
C. albipes *Theob.;* New Amsterdam
Janthinosoma lutzii *Theob.;* Rio de Janeiro
J. musica *Say;* Rio and New Amsterdam
Mucidus alternans *Westw.;* Australia
Eretmapodites quinquevittata *Theob.;* Uganda
Desvoidea obturbans *Walk.;* India
D. panalectros *Giles;* India
Stegomyia fasciata *Fabr.*
S. scutellaris *Walk.;* Malay states
Scutomyia (Stegomyia) notoscripta *Skuse;* Australia and India
Theobaldia annulata *Meig.;* England

T. incidens *Thomson;* North America
T. spathipalpis *Rondani;* Madeira
Culex alboannulatus *Macq.;* Australia
C. annulioris *Theob.;* Transvaal
C. annulirostris *Skuse;* Australia and New Guinea
C. canadensis *Theob.;* Canada
C. cantans *Meig.;* Canada
C. concolor *Desv.;* India
C. confirmatus *Arrib.;* Rio de Janeiro
C. cylindricus *Theob.;* Australia
C. diversus *Theob.;* Europe
C. fatigans *Wied.*
C. gelidus *Theob.;* Malay states
C. luteolateralis *Theob.;* west and central Africa
C. mimeticus *Noè;* India and Malay states
C. occidentalis *Skuse;* Australia
C. ochraceus *Theob.;* central Africa
C. pulciventer *Giles;* India
C. sylvestris *Theob.;* Canada
C. taeniorhynchus *Wied.;* Rio de Janeiro
C. tigripes *Grandpré;* Mauritus
C. viridiventer *Giles;* India
C. vittiger *Skuse;* Australia
Melaniconion atratus *Theob.;* Jamaica
Grabhamia pygmaeus *Theob.;* West Indies
G. vittata *Theob.;* New Mexico
Taeniorhynchus aurifer *Theob.;* Uganda
T. brevicellulus *Theob.;* Malay states
T. conopas *Frau.;* Malay states
T. fasciolatus *Arrib.;* British Guiana
T. fulvus *Wied.;* Para
Mansonia annulifera *Theob.;* India
M. annulipes *Walk.;* Malay states
M. titillans *Walk.;* British Guiana
M. uniformis *Theob.;* Malay states and Africa
Deinocerites cancer *Theob.;* West Indies and Uganda
Uranotaenia socialis *Theob.;* West Indies
Aedeomyia squammipenna *Arrib.;* Malay states
Phoniomyia longirostris *Theob.;* Trinidad
Sabethes remipes *Wied.;* Brazil
Limatus durhamii *Theob.;* para
Trichoprosopon (Joblotia) nivipes *Theob.;* Trinidad

Lepidoptera

Anaea andria *Scud.*[6]
Ceratomia catalpae *Bdv.*[6]
Eubaphe rubicundaria *Hübn.*[1]
Arachnis picta, *Pack.*[1]
Apantesis incorrupta *Hy. Edw.*[1]
Parasemia plantaginis *Linn.*[1]
Laphygma frugiperda *Sm. & Abb.*[6]
Oncocnemis augustus *Harv.*[1]
Heliothis armiger *Hübn.*[6]
Autographa brassicae *Riley*[6]
Synedla howlandii *Grote*[1]
Homoptera rubi *Hy. Edw.*[1]
Nycteola protecila *Dyar*[1]
Hydriomena *sp.*[1]
Triprocris smithsonianus *Clem.*[1]
Loxostege sticticalis *Linn.*[1]
L. commixtalis *Walk.*[1]
L. coloradensis *Gr. Rob.*[1]
Cornifrons simalis *Grote*[1]
Crambus teterrellus *Zinck.*[1]
Thaumatopsis repanda *Grote*[1]
Hulstea undulatella *Clem.*[1]
Homoeosoma electellum *Hulst.*[1]
Ethmia discostrigella *Chamb.*[1]

Neuroptera

Raphidia oblita *Hag.*[1]
Chrysopa externa *Hag.*[1]
Brachynemurus nigrilabris *Hag.*[1]
Platyphylax designata *Walk.*[1]

Hemiptera

Homaloporus congruus *Uhl.*[1]
Perillus claudus *Say*[1]
Apateticus marginiventris *Stal.*[1]
Cosmopepla conspicillaris *Dallas*[1]
Carpocoris lynx *Fabr.*[1]
Thyanta custator *Fabr.*[1]
T. rugulosa *Say*[1]
Archimerus calcarator *Fabr.*[1]
Catorhintha guttula *Fabr.*[1]
Ficana apicalis *Dallas*[1]
Alydus quinquespinosus *Say*[1]
A. pluto *Uhl.*[1]
Darmistus subvittatus *Stal.*[1]
Scolopocerus secundarius *Uhl.*[1]
Nysius minutus *Uhl.*[1]
Orsillus scolopax *Say*[1]
Ischnodemus falicus *Say*[1]
Geocoris pallens *Stal.*[1]
Heraeus insignis *Uhl.*[1]
Pamera bilobata *Say*[1]
Trapezonotus nebulosus *Fall.*[1]
Emblethis arenarius *Linn.*[1]
Rhyparochromus floralis *Uhl.*[1]
Melanocoryphus bicrucis *Say*[1]
M. facetus *Say*[1]
M. admirabilis *Uhl.*[1]
Lygaeus reclivatus *Say*[1]
Largus cinctus *H. Sch.*[1]
Dysdercus mimus *Say*[1]
D. albidiventris *Stal.*[1]
Trigonotylus pulcher *Reut.*[1]
Callimiris tarsalis *Reut.*[1]
Resthenia insignis *Say*[1]
Lomatopleura caesar *Reut.*[1]
Hadronema militaris *Uhl.*[1]
Poeciloscytus[1]
Systratiotus americanus *Reut.*[1]
Camptobrochis nebulosus *Uhl.*[1]
Capsus brachycorus *Uhl.*[1]
Pycnoderes 4-maculatus *Guer.*[1]
Labops hesperius *Uhl.*[1]
Dicyphus californicus *Stal.*[1]
Orectoderus[1]
Anthocoris melanocerus *Reut.*[1]
Coriscus kalmii *Reut.*[1]
Repipta taurus *Fabr.*[1]
Apiomerus pictipes *H. Sch.*[1]
A. ventralis *Say*[1]
Hygrotrechus remigis *Say*[1]
Limnotrechus marginatus *Say*[1]
Hebrus concinnus *Uhl.*[1]
Cicada *var.* cassinii *Fish.*[6]
Microvelia[1]
M. hornii *Uhl.*[1]
Salda interstitialis *Say*[1]
S. pallipes *Fabr.*[1]
Galgulus oculatus *Fabr.*[1]
Anisops platycnemis *Fieb.*[1]
Corisa abdominalis *Say*[1]

Coccidae

Parlatoria pergandii *Comst.*[2] on Japanese orange; Stanford University Cal.
P. florinia[2]; Gifu-Ken, Japan
Lepidosaphes ulmi *Linn.*[2] on apple; Stanford University Cal.
L. newsteadi tokionis *Kuw.*[2] on Codiaeum; Tokyo, Japan
L. gloverii *Pack.*[2] on orange; Kiushiu, Japan
L. crawii *Ckll.*[2] Angio Saitama-Ken, Japan
Odonaspis secreta *Ckll.*[2] on bamboo; Hikosan, Kiushiu, Japan
Chrysomphalus rossi *Mask.*[2] on Araucaria bidwillii; Stanford University Cal.
C. obscurus *Comst.*[7] on Quercus coccinea; Columbus O.
C. kelloggi *Kuw.*[2] Chikujo-gun, Kiushiu, Japan
C. aurantii citrinus *Coq.*[2] Mazatlan, Mexico
C. aonidum *Linn.*[2] on fern; Tokyo, Japan
Pseudaonidia paeoniae *Ckll.*[2] on Aoskia; Hikosan, Kiushiu, Japan
Aspidiotus rapax *Comst.*[2,8] on laurel; Stanford University Cal.
A. perniciosus *Comst.*[2] on peach; Stanford University Cal.
A. lataniae *Sign.*[2] Tokyo, Japan
A. hederae *Vall.*[2] on Sequoia sempervirens; Stanford University Cal.

A. glanduliferus *Ckll.*[1] on Pinus sylvestris; Columbus O.

A. coniferarum shastae *Cole*[2] on cypress; Lake co. Cal.

A. californicus *Cole*[2] on Pinus ponderosa; Cobb Mt, Lake co. Cal.

A. aesculi *Johns.*[2] on buckeye; San Mateo Cal.

Leucaspis kelloggi *Cole*[2] on Abies concolor; Mt Shasta Cal.

Poliaspis pini *Mask.*[2] on Abies firma; Tokyo, Japan

Aulacaspis rosae *Bouché*[2] on wild rose; Palo Alto Cal.

A. pentagona *Targ.*[2] on cherry, plum; Tokyo, Japan

A. crawii *Ckll.*[2] on Yumi; Tokyo, Japan

Epidiaspis pyricola *Del Guer.*[2] on prune; Milliken, Santa Clara co. Cal.

Diaspis bromeliae *Kern.*[2] on palm; San José Cal.

Chionaspis spartinae *Comst.*[2] on Spartina stricta; Palo Alto Cal.

C. salicis-nigrae *Walsh*[1] on Salix cordata; Columbus O.

C. quercus *Comst.*[2] on Quercus chrysolepis; Stevens creek, Mountain View Cal.

C. pinifoliae *Fitch*[2] on Torreya californica; Stevens creek, Mountain View Cal.

C. ortholobis *Comst.*[2] on dogwood; Mountain View Cal.

C. gleditsiae *Sand.*[1] on Gleditsia tricanthos; Columbus O.

C. americana *Johns.*[1] on Ulmus americana; Columbus O.

Aclerda tokionis *Ckll.*[2]; Tokyo, Japan

A. californica *Ehrh.*[2] on bunch grass; Mountain View Cal.

Physokermes insignicola *Craw.*[2] on Pinus radiata; San Mateo Cal.

Saissetia oleae *Bern.*[2,3] on vine; San Mateo Cal.

Eulecanium quercitronis kermoides *Tyr.*[2] on Quercus agrifolia; Mountain View Cal.

E. armeniacum *Craw.*[2] on prune; Stanford University Cal.

E. adenostomae *Kuw.*[2] on Adenostoma fasciculatum; Black Mt Cal.

Coccus hesperidium *Linn.*[2,3] on rose; Arcada Cal.

Eucalymnatus tessellatus *Sign.*[2] on fern; San Francisco Cal.

Ceroplastes ceriferus *And.*[2] on tea

Pulvinaria rhois *Ehrh.*[2] on Rhus diversiloba; near Mountain View Cal.

P. aurantii *Ckll.*[2] on tea; Kokura, Kiushiu, Japan

Pseudococcus pseudonipae *Ckll.*[2] on palm; San Francisco Cal.

Phenacoccus dubia[2] on Diospyros kaki; Kusatsu, Shiga-Ken, Japan

Dactylopius dudleyi *Cole.*[2] on Cupressus macnabiona; Shasta Cal.

D. sp. *Coq.*[2] on cypress; Del Monte Cal.

Eriococcus graminis *Mask.*[2] on bamboo; Gifu-Ken, Japan.

E. artemisiae *Kuw.*[2] on Artemesia californica; Santa Clara county Cal.

E. araucariae *Mask.*[2] on Araucaria excelsa; Berkley Cal.

E. adenostomae *Ehrh.*[2] on Adnostoma fasciculatum; Black Mt Cal.

Gossyparia spuria *Modeer.*[2] on elm; Stanford University Cal.

Cerococcus quercus *Comst.*[2] on oak; Mountain View Cal.

C. ehrhorni *Ckll.*[2,3] on live oak; Mountain View Cal.

Lecaniodiaspis quercus *Ckll.*[2] on oak

Asterolecanium quercicola *Bouché*[2] on Quercus lobata, Stanford University Cal.

Icerya purchasi *Mask.*[2] on Scotch broom; Stanford University Cal.

Orthoptera

Hypochlora alba *Dodge*[1]
Campylacantha olivacae *Scud.*[1]
Hesperottetix viridis *Thos.*[1]
H. pratensis *Scud.*[1]
H. speciosus *Scud.*[1]
Aeoloplus regalis *Dodge*[1]
Podisma dodgei *Thos.*[1]
Melanoplus lakinus *Scud.*[1]
M. differentialis *Thos.*[6]
M. fiabellifer *Scud.*[1]
M. bowditchi *Scud.*[1]
M. flavidus *Scud.*[1]
M. fiabellatus *Scud.*[1]
M. packardii *Scud.*[1]
M. minor *Scud.*[1]
M. luridus *Dodge*[1]
M. bivittatus *Say*[1]
Phoetaliotes nebrascensis (nebrascensis) *Thom.*[1]
P. nebrascensis (volucris) *Dodge*[1]
Schistocerca americana *Drury*[6]

Plecoptera

Perla ephyre *Newm.*[4]
P. lurida *Hag.*[4]
P. xanthenes *Say*[4]

EXCHANGE LIST

The following is a partial list of the species of insects in the New York State Museum which are available for exchange purposes. In return we are specially desirous, as above stated, of securing specimens of economic importance in different sections of this country and of foreign countries, and particularly of forms likely to become destructive if established in this State.

Hymenoptera

Bombus fervidus *Fabr.*
B. ternarius *Say*
B. terricola *Kirby*
B. vagans *Smith*
Xylocopa virginica *Drury*
Megachile latimanus *Say*
Andrena vicina *Smith*
Vespa arenaria *Fabr.*
V. consobrinus *Sauss.*
V. diabolica *Sauss.*
V. maculata *L.*
Polistes pallipes *St Farg.*
Odynerus capra *Sauss.*
Philanthus solivagus *Say*
Monedula ventralis *Say*
Bembex fasciata *Fabr.*
Chalybion caeruleum *Linn.*
Pelopoeus cementarius *Drury*
Ammophila communis *Cress.*
Aporus biguttatus *Fabr.*
A. marginatus *Say*
Pelecinus polyturator *Drury*
Apanteles congregatus *Say*
Lampronota americana *Cress.*
Pimpla conquisitor *Say*
P. inquisitor *Say*
Theronia fulvescens *Cress.*
Ephialtes irritator *Fabr.*
Thalessa lunator *Fabr.*
Paniscus geminatus *Say*
Anomalon exile *Prov.*
Ichneumon centrator *Say*
I. cincticornis *Cress.*
I. confirmatus *Cress.*
I. scelestus *Cress.*
I. unifasciatorius *Say*
I. laetus *Brullé*
Tremex columba *Linn.*
Allantus basillaris *Say*
Dolerus arvensis *Say*
D. sericeus *Say*
Lygaeonematus erichsonii *Hartig*
Trichiocampus viminalis *Fallen*
Cimbex americana *Leach*

Coleoptera

Cratoparis lunatus *Fabr.*
Tomicus calligraphus *Germ.*
T. cacographus *Lec.*
T. pini *Say*
T. balsameus *Lec.*
Xyleborus celsus *Eich.*
X. dispar *Fabr.*
Cossonus platalea *Say*
Calandra granaria *Linn.*
Balaninus nasicus *Say*
Mononychus vulpeculus *Fabr.*
Cryptorhynchus lapathi *Linn.*
Conotrachelus nenuphar *Hbst.*
Gymnetron teter *Fabr.*
Tachypterus quadrigibbus *Say*
Magdalis armicollis *Say*
M. barbita *Say*
M. perforata *Horn*
Lixus concavus *Say*
Hylobius pales *Hbst.*
Pissodes strobi *Peck*
Phytonomus nigrirostris *Fabr.*
P. punctatus *Fabr.*
Cyphomimus dorsalis *Horn*
Pandeletejus hilaris *Hbst.*
Otiorhynchus ovatus *Linn.*
Rhynchites bicolor *Fabr.*
Epicauta vittata *Fabr.*
E. cinerea *Forst.*
E. pennsylvanica *DeG.*
Macrobasis unicolor *Kirby*
Henous confertus *Say*
Meloe angusticollis *Say*
Notoxus anchora *Hentz.*
N. bifasciatus *Lec.*
Mordella marginata *Melsh.*
Anaspis flavipennis *Hald.*
Nacerdes melanura *Linn.*
Pytho americanus *Kirby*
Melandrya striata *Say*
Cistela sericea *Say*
Boletotherus bifurcus *Fabr.*
Hoplocephala bicornis *Oliv.*
Diaperis hydni *Fabr.*
Paratenetus punctatus *Sol.*
Tribolium ferrugineum *Fabr.*
Tenebrio tenebrioides *Beauv.*
T. molitor *Linn.*
Xylopinus saperdioides *Oliv.*
Scotobates calcaratus *Fabr.*
Merinus laevis *Oliv.*
Iphthimus opacus *Lec.*
Nyctobates pennsylvanica *DeG.*
Eleodes tricostata *Say*
Bruchus obtectus *Say*
Chelymorpha argus *Licht.*
Coptocycla aurichalcea *Fabr.*
Odontota rubra *Web.*
Microrhopala vittata *Fabr.*
Dibolia borealis *Chev.*
Phyllotreta sinuata *Steph.*
Systena hudsonias *Forst.*
S. frontalis *Fabr.*
S. bitaeniata *Lec.*
Crepidodera rufipes *Linn.*
C. helxines *Linn.*
C. cucumeris *Harr.*
Haltica bimarginata *Say*
Disonycha alternata *Ill.*
D. pennsylvanica *Ill.*
D. collaris *Fabr.*
Galerucella decora *Say*
G. luteola *Müll.*
Trirhabda canadensis *Kirby*
Diabrotica 12-punctata *Oliv.*
D. vittata *Fabr.*
Cerotoma caminea *Fabr.*
Lina scripta *Fabr.*
Gastroidea polygoni *Linn.*
Chrysomela similis *Rog.*
C. elegans *Oliv.*
C. bigsbyana *Kirby*
Doryphora clivicollis *Kirby*
D. 10-lineata *Say*
Prasocuris varipes *Lec.*
Nodonota brunnea *Fabr.*
N. tristis *Oliv.*
Graphops pubescens *Melsh.*
Metachroma marginalis *Cr.*
Typophorus aterrima *Oliv.*
Chrysochus auratus *Fabr.*
Glyptoscelis pubescens *Fabr.*
Fidia viticida *Walsh*
Xanthonia 10-notata *Say*
Monachus sàponatus *Fabr.*
Chlamys plicata *Fabr.*
Babia 4-guttata *Oliv.*
Crioceris asparagi *Linn.*

C. 12-punctata *Linn.*
Lema trilineata *Oliv.*
Syneta ferruginea *Germ.*
Orsodachna atra *Ahr.*
Donacia cincticornis *Newm.*
D. rufa *Say*
Tetraopes tetraophthalmus *Forst.*
Saperda tridentata *Oliv.*
Liopus alpha *Say*
Monohammus maculosus *Hald.*
M. scutellatus *Say*
M. confusor *Kirby*
Leptura lineola *Say*
L. exigua *Newm.*
L. cordifera *Oliv.*
L. canadensis *Fabr.*
L. rubrica *Say*
L. vagans *Oliv.*
L. proxima *Say*
L. vittata *Germ.*
Typocerus velutinus *Oliv.*
Strangalia acuminata *Oliv.*
Rhagium lineatum *Oliv.*
Desmocerus palliatus *Forst.*
Euderces picipes *Fabr.*
Clytanthus ruricola *Oliv.*
Neoclytus erythrocephalus *Fabr.*
Xylotrechus colonus *Fabr.*
Cyllene robiniae *Forst.*
Molorchus bimaculatus *Say*
Elaphidion villosum *Fabr.*
Callidium antennatum *Newm.*
Prionus laticollis *Drury*
Orthosoma brunneum *Forst.*
Parandra brunnea *Fabr.*
Trichius affinis *Gory*
Osmoderma scabra *Beauv.*
O. eremicola *Knoch.*
Euphoria inda *Linn.*
Chalepus trachypygus *Burm.*
Pelidnota punctata *Linn.*
Strigoderma arboricola *Fabr.*
Anomala lucicola *Fabr.*
Lachnosterna fusca *Froh.*
L. tristis *Fabr.*
Macrodactylus subspinosus *Fabr.*
Serica trociformis *Burm.*
Dichelonycha elongata *Fabr.*
D. albicollis *Burm.*
Hoplia modesta *Hald.*
Geotrupes splendidus *Fabr.*
Bolboceras farctus *Fabr.*
Aphodius fossor *Linn.*
A. fimetarius *Linn.*
A. granarius *Linn.*
A. inquinatus *Hbst.*
Onthophagus pennsylvanicus *Harold*
O. hecate *Panz.*
Phanaeus carnifex *Linn.*
Copris anaglypticus *Say*
Canthon laevis *Drury*
Passalus cornutus *Fabr.*
Ceruchus piceus *Web.*
Dorcus parallelus *Say*
Enmearthron thoracicornis *Zeigl.*
Lyctus opaculus *Lec.*
Sitodrepa panicea *Linn.*
Ptinus quadrimaculatus *Melsh.*
Clerus quadriguttatus *Oliv.*
C. nigriventris *Lec.*
C. analis *Lec.*
Trichodes nuttali *Kirby*
Telephorus carolinus *Fabr.*
T. scitulus *Say*
T. rotundicollis *Say*
T. bilineatus *Say*
Podabrus rugulosus *Lec.*
Chauliognathus pennsylvanicus *DeG.*
C. marginatus *Fabr.*
Photuris pennsylvanicus *DeG.*
Photinus scintillans *Say*
Pyropyga nigricans *Say*
Ellychnia corrusca *Linn.*
Lucidota atra *Fabr.*
Calopteron reticulatum *Fabr.*
Brachys ovata *Web.*
Agrilus anxius *Gory*
A. ruficollis *Fabr.*
Acmeodera pulchella *Hbst.*
Chrysobothris femorata *Fabr.*
C. floricola *Gory*
C. dentipes *Germ.*
C. scabripennis *Lap. & Gory*
C. pusilla *Lap. & Gory.*
Buprestis maculiventris *Say*
Dicerca divaricata *Say*
Chalcophora virginiensis *Drury*
Asaphes decoloratus *Say*
Oxygonus obesus *Say*
Corymbites inflatus *Say*

C. cylindriformis *Hbst.*
Limonius confusus *Lec.*
Melanotus communis *Gyll.*
Dolopius lateralis *Esch.*
Elater nigricollis *Hbst.*
E. obliquus *Say*
Cryptohypnus planatus *Lec.*
Alaus oculatus *Linn.*
Tharops ruficornis *Say*
Tenebrioides corticalis *Melsh.*
Ips quadriguttatus *Fabr.*
Omosita colon *Linn.*
Nitidula bipustulata *Linn.*
Conotelus obscurus *Er.*
Colastus truncatus *Rand.*
Hister parallelus *Say*
Anthrenus scrophulariae *Linn.*
A. verbasci *Linn.*
Attagenus piceus *Oliv.*
Dermestes lardarius *Linn.*
Byturus unicolor *Say*
Triphyllus humeralis *Kirby*
Mycetophagus punctatus *Say*
M. flexuosus *Say*
Silvanus surinamensis *Linn.*
Tritoma thoracica *Say*
T. humeralis *Fabr.*
Lycoperdina ferruginea *Lec.*
Epilachna borealis *Fabr.*
Brachyacantha ursina *Fabr.*
Chilocorus bivulnerus *Muls.*
Psyllobora 20-maculata *Say*
Anatis ocellata *Linn.*
Adalia bipunctata *Linn.*
Coccinella trifasciata *Linn.*
C. 9-notata *Hbst.*
C. transversalis *Muls.*
C. sanguinea *Linn.*
Hippodamia 13-punctata *Linn.*
H. parenthesis *Say*
Megilla maculata *DeG.*
Tachinus fimbriatus *Grav.*
Stenus flavicornis *Er.*
Paederus littorarius *Grav.*
Philonthus aeneus *Rossi*
Staphylinus cinnamopterus *Grav.*
S. maculosus *Grav.*
Creophilus villosus *Grav.*
Listotrophus cingulatus *Grav.*
Silpha surinamensis *Fabr.*
S. lapponica *Hbst.*
S. inaequalis *Fabr.*
S. noveboracensis *Forst.*
S. americana *Linn.*
Necrophorus marginatus *Fabr.*
N. pustulatus *Hersch*
N. tomentosus *Web.*
Sphaeridium scarabaeoides *Linn.*
Hydrobius fuscipes *Linn.*
H. globosus *Say*
Hydrocharis obtusatus *Say*
Hydrophilus triangularis *Say*
H. glaber *Hbst.*
Dineutes assimilis *Aube*
Gyrinus ventralis *Kirby*
G. picipes *Aube*
Acilius semisulcatus *Aube*
Dytiscus fasciventris *Say*
Colymbetes sculptilis *Harr.*
Agabus punctulatus *Aube*
Ilybius biguttatus *Germ.*
Deronectes griseostriatus *DeG.*
Laccophilus maculosus *Germ.*
Cnemidotus 12-punctatus *Say*
Anisodactylus rusticus *Say*
A. discoideus *Dej.*
A. interstitialis *Say*
Bradycellus rupestris *Say*
Harpalus erraticus *Say*
H. viridiaeneus *Beauv.*
H. caliginosus *Fabr.*
H. pennsylvanicus *DeG.*
H. herbivagus *Say*
Agonoderus pallipes *Fabr.*
Chlaenius sericeus *Forst.*
C. tricolor *Dej.*
C. pennsylvanicus *Say*
C. tomentosus *Say*
Lebia grandis *Hentz*
L. viridis *Say*
Galerita janus *Fabr.*
Calathus gregarius *Say*
Dicaelus elongatus *Bon.*
Amara impunctricollis *Say*
Pterostichus stygicus *Say*
P. lucublandus *Say*
P. corvinus *Dej.*
P. patruelis *Dej.*
P. femoralis *Kirby*
Tachys nanus *Gyll.*

Bembidium quadrimaculatum *Linn.*
Scarites subterraneus *Fabr.*
Pasimachus elongatus *Lec.*
Nebria sahlbergi *Fisch.*
Elaphrus ruscarius *Say*
Calosoma calidum *Fabr.*
Carabus vinctus *Web.*
Omophron americanum *Dej.*
Cicindela lecontei *Hald.*
C. sexguttata *Fabr.*
C. generosa *Dej.*
C. vulgaris *Say*
C. repanda *Dej.*
C. purpurea Oliv.
C. 12-guttata *Dej.*
C. punctulata *Fabr.*

Diptera

Physocephala furcillata *Will.*
Drosophila ampelophila *Loew.*
Chloropisca variceps *Loew.*
Piophila casei *Linn.*
Lauxania flaviceps *Loew.*
Trypeta longipennis *Wied.*
Rhagoletis cingulata *Loew.*
Phorbia fusciceps *Rondani*
Pollenia rudis *Fabr.*
Belvoisia unifasciata *Desv.*
Ocyptera carolinae *Desv.*
Tachina mella *Walk.*
Echinomyia algens *Wied.*
Gonia capitata *DeG.*
Archytas analis *Fabr.*
Spilomyia fusca *Loew.*
Syritta pipiens *Linn.*
Helophilus similis *Macq.*
Eristalis dimidiatus *Wied.*
E. tenax *Linn.*
E. transversus *Wied.*
Rhingia nasica *Say*
Sphaerophoria cylindrica *Say*
Mesograpta marginata *Say*
Syrphus lesueurii *Macq.*
S. ribesii *Linn.*
S. americanus *Wied.*
Platycherus quadratus *Say*
Tabanus atrata *Fabr.*
T. reinwardtii *Wied.*
T. lineola *Fabr.*
Therioplectes microcephalus *O. S.*
Chrysops vittatus *Wied.*
C. excitans *Walk.*
C. niger *Macq.*
Pangonia tranquilla *O. S.*
Bibio albipennis *Linn.*

Lepidoptera

Papilio glaucus turnus *Linn.*
Pontia rapae *Linn.*
Eurymus philodice *Godt.*
Argynnis aphrodite *Fabr.*
A. atlantis *Edw.*
Brenthis myrina *Cram.*
B. bellona *Fabr.*
Phyciodes tharos *Dru.*
Eugonia j-album *Boisd.*
Euvanessa antiopa *Linn.*
Vanessa atalanta *Linn.*
Basilarchia arthemis *Dru.*
B. archippus *Cram.*
Anosia plexippus *Linn.*
Feniseca tarquinius *Fabr.*
Heodes hypophleas *Boisd.*
Samia cecropia *Linn.*
Callosamia promethia *Dru.*
Lycomorpha pholus *Dru.*
Ctenucha virginica *Charp.*
Eubaphe aurantiaca *Hub.*
Haploa confusa *Lyman*
Estigmene acraea *Dru.*
Isia isabella *Sm. & Abb.*
Diacrisia virginica *Fabr.*
Apantesis virgo *Linn.*
A. parthenice *Stretch.*
Halisidota tessellaris *Sm. & Abb.*
H. caryae *Harr.*
Alypia octomaculata *Fabr.*
Hadena passer *Guen.*
H. dubitans *Walk.*
H. devastatrix *Brace.*
H. arctica *Boisd.*
Pyrophila pyramidoides *Guen.*
Adelphagrotis prasina *Fabr.*
Peridroma margaritosa *Harr.*
Noctua smithii *Snell.*

N. bicarnea *Guen.*
N. c-nigrum *Linn.*
N. clandestina *Harr.*
Feltia subgothica *Haw.*
F. jaculifera *Guen.*
Paragrotis redimicula *Morr.*
Mamestra purpurissata *Grote*
M. meditata *Grote*
M. renigera *Steph.*
M. olivacea *Morr.*
Nephelodes minians *Guen.*
Heliophila unipuncta *Haw.*
H. luteopallens *Smith*
Tricholita signata *Streck.*
Gortyna nictitans *Bork.*
Orthosia helva *Grote*
Plusia aerea *Hübn.*
P. aeroides *Grote*
Autographa bimaculata *Steph.*
A. precationis *Guen.*
A. brassicae *Riley*
A. rectangula *Kirby*
A. u-aureum *Guen.*
A. falcigera *Kirby*
Eustrotia carneola *Guen.*
Notolophus badia *Hy. Edw.*
Hemerocampa leucostigma *Abb. & Sm.*
Eudule mendica *Walk.*
Cingilia catenaria *Dru.*
Sabulodes transversata *Dru.*
Sesia tipuliformis *Clerck.*
Desmia funeralis *Hübn.*
Evergestis straminalis *Hübn.*
Tholeria reversalis *Guen.*

Trichoptera

Leptocerus resurgens *Walk.*
Hydropsyche scalaris *Hag.*
Halesus guttifer *Walk.*
Goniotaulius dispectus *Walk.*
Neuronia postica *Walk.*

Mecoptera

Panorpa rufescens *Rambur*
P. maculosa *Hag.*
Bittacus strigosus *Hag.*

Neuroptera

Polystoechotes punctatus *Fabr.*
Corydalis cornuta *Linn.*

Hemiptera

Canthophorus cinctus *Beauv.*
Podisus maculiventris *Say*
P. placidus *Uhler*
Brochymena 4-pustulata *Fabr.*
Cosmopepla carnifex *Fabr.*
Euschistus servus *Say*
E. tristigmus *Say*
E. fissilis *Uhler*
E. variolarius *P. B.*
Coenus delius *Say*
Pentatoma juniperana *Linn.*
Murgantia histrionica *Hahn.*
Nezara hilaris *Say*
Anasa tristis *DeG.*
Alydus eurinus *Say*
Leptocoris trivittatus *Say*
Blissus leucopterus *Say*
Lygaeus turcicus *Fabr.*
Leptopterna dolobrata *Linn.*
Calocoris rapidus *Say*
Lygus pratensis *Linn.*
Poecilocapsus lineatus *Fabr.*
Capsus ater *Linn.*
Piesma cinerea *Say*
Corythuca arcuata *Say*
Phymata wolffii *Her. Sch.*
Nabis rufusculus *Reut.*
Acholla multispinosa *DeG.*
Limnotrechus marginatus *Say*
Belostoma americana *Leid.*
Notonecta undulata *Say*
Cicada tibicen *Linn.*
C. septendecim *Linn.*
Publilia concava *Say*

P. bicinctus *Godg.*
Ceresa bubalus *Fabr.*
C. diceros *Say*
Stictocephala inermis *Fabr.*
Smilia camelus *Fabr.*
Telamona ampeloposidis *Harr.*
Enchenopa binotata *Say*
Ormenis pruinosus *Say*
Aphrophora saratogensis *Fitch*
A. quadrangularis *Say*
Clastoptera proteus *Fitch*
Diedrocephala mollipes *Say*
D. coccinea *Forst.*
D. noveboracensis *Fitch*
Helochara communis *Fitch*
Thamnotettix clitellarius *Say*
Emponasca rosae *Harr.*
Trioza tripunctata *Fitch*

Coccidae

Lepidosaphes ulmi *Linn.*
Aspidiotus perniciosus *Comst.*
A. ostreaeformis *Curt.*
A. ancylus *Putn.*
A. abietis *Schr.*
Aulacaspis rosae *Bouché*
Diaspis boisduvalii *Sign.*
Chionaspis furfura *Fitch*
C. euonymi *Comst.*
C. americana *Johns.*
Eulecanium nigrofasciatum *Perg.*
Pulvinaria innumerabilis *Rathv.*
Gossyparia spuria *Modeer*
Kermes galliformis *Riley*

CONTRIBUTIONS TO COLLECTION OCT. 16, 1902–OCT. 15, 1903

Hymenoptera

Bombus vagans Smith, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Melissodes sphaeralceae Ckll., adult, Sep. 10, **T. D. A. Cockerell**, Pecos N.M.

Megachile cleomi? Ckll., adult, Sep. 10, **T. D. A. Cockerell**, Pecos N.M.

M. sapelloni? Ckll., adult, Sep. 10, **T. D. A. Cockerell**, Pecos N.M.

M. monardarum Ckll., adult, Sep. 10, **T. D. A. Cockerell**, Pecos N.M.

Perdita stotteri Ckll., adult, Sep. 10, **T. D. A. Cockerell**, Pecos N.M.

Camponotus herculaneus Linn., adult, May 21, **F. R. Calkins**, Ossining N.Y.

C. var. pennsylvanicus DeG. large black ant, work on balsam, Oct. 31, **Jonas H. Brooks**, Albany N.Y.

Pteromalus puparum Linn., adult, from Euvanessa antiopa Linn., Feb. 8, **J. H. Cook**, Albany N.Y.

Biorhiza forticornis Walsh, oak fig gall on oak, Aug. 24, **C. H. Peck**, Albany N.Y.

Urocerus tricolor Prov., adult, July 18, **James Roy & Co.**, Troy N.Y.

Dolerus arvensis Say, adult, Ap. 30, **F. R. Calkins**, Ossining N.Y.

Emphytus cinctipes Nort., July 11, **C. J. Locke**, Ogdensburg N.Y.

Coleoptera

Phytonomus nigrirostris **Fabr.**, adult, on clover, Mar. 25, **F. R. Calkins**, Ossining N.Y.

Mycetochares binotata Say, adult, July 11, **C. J. Locke**, Ogdensburg N.Y.

Spermophagus robinae Sch., adult, June 6, **Reinlein Gasoline Torch Co.**, Mt Vernon Ill.

Chelymorpha argus Licht., argus beetle, adult, June 6, **C. J. Locke**, Ogdensburg N.Y.

Coptocycla bicolor Fabr., golden tortoise beetle, adult on peach leaves, May 30, **Emma S. Thomas**, Schoharie N.Y. Same, adult, June 6, **C. J. Locke**, Ogdensburg N.Y.

Galerucella luteola Müll., elm leaf beetle, adult on elm, May 25, **F. R. Calkins**, Ossining N.Y. Same, eggs and larvae on elm, July 13, **F. R. Calkins**, Ossining N.Y.

Diabrotica vittata Fabr., adult on squash, May 25, **F. R. Calkins**, Ossining N.Y.

Chrysomela bigsbyana Kirby, adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Doryphora clivicollis Kirby, adult, July 11, **C. J. Locke**, Ogdensburg N.Y.

Chrysochus auratus Fabr., golden gilt beetle, adults on dogbane, July 16, **J. Jay Barden**, Dansville N.Y. Same, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Diabrotica vittata Fabr., striped cucumber beetle, adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Crioceris 12-punctata Linn., 12-spotted asparagus beetle, adult, June 3, **C. H. Peck**, Menands N.Y.

C. asparagi Linn., asparagus beetle, adult on asparagus, May 25, **C. L. Williams**, Glens Falls N.Y. Same, adult on asparagus Sep. 3, **W. F. Greene**, Mt Vernon N.Y.

Tetraopes tetraophthalmus Forst., adult, July 11, **C. J. Locke**, Ogdensburg N.Y.

Oberea bimaculata Oliv., raspberry cane girdler work on raspberry canes, June 24, **John U. Metz**, Swormville N.Y.

Centrodera decolorata Harr., adult on butternut, Jan. 5, **G. S. Graves**, Newport N.Y.

Desmocerus palliatus Forst., adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Cyllene robiniae Forst., locust borer, Oct. 18, **W. C. Hitchcock**, Pittstown N.Y. Same, larvae on locust, June 16, **M. T. Richardson**, Brooklyn N.Y.

Prionus laticollis Drury, broad-necked Prionus, adult, July 20, **Miss M. J. Tyers**, Dobbs Ferry N.Y.

Ligyrus gibbosus DeG. adult, June 6, **Reinlein Gasoline Torch Co.**, Mt Vernon Ill.

Pelidnota punctata Linn., spotted grapevine beetle, Oct. 18, **W. C. Hitchcock**, Pittstown N.Y.

Lachnosterna fusca Fröhl., larva, June 25, **C. J. Locke**, Ogdensburg N.Y.

Diplotaxis liberta Germ., adults on peach, Sep. 24, **J. R. Crandall**, Hauppauge N.Y.

Macrodactylus subspinosus Fabr., rose beetle, adult on fruit trees, June 16, **H. A. Jordan**, Coxsackie N.Y.

Dichelonycha elongata Fabr., adult, June 6, **C. J. Locke**, Ogdensburg N.Y.

Lyctus parallelopipedus Melsh., adults in ash, July 10, **Joseph P. McHugh & Co.**, New York.

Collops vittatus Say, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Telephorus carolinus Fabr., adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Podabrus rugulosus Lec., adult, June 25, **C. J. Locke**, Ogdensburg N.Y. Same, adult, July 11, **C. J. Locke**, Ogdensburg N.Y.

Lampyrid, larva, June 12, **George S. Graves**, Newport N.Y.

Chalcophora virginiensis Drury, adults, Oct. 18, **W. C. Hitchcock**, Pittstown N.Y.

Melanotus communis Gyll., adult, July 11, **C. J. Locke**, Ogdensburg N.Y.

Dolopius lateralis Esch., adult, July 11, **C. J. Locke**, Ogdensburg N.Y.

Alaus oculatus Linn., owl beetle, adult, July 9, **C. L. Daggett**, Albany N.Y. Same, adults, July 27, **Fred G. Carnes**, W. Chazy N.Y.

Anthrenus verbasci Linn., adult, May 25, **F. R. Calkins**, Ossining N.Y.

Chilocorus bivulnerus Muls., twice-stabbed ladybeetle, adult (feeding on San José scale) June 13, **Mr Hotchkin**, Binghamton N.Y.

Adalia bipunctata Linn., two-spotted lady beetle, adult, July 31, **George S. Graves**, Newport N.Y. Same on Norway maple, June 12, **M. F. Tiger**, Patchogue N.Y. Same, larvae on rose, June 3, **Mrs A. G. Dana**, Far Rockaway N.Y.

Coccinella transversalis Muls., adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

C. 9-notata Herbst, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Hydrophilus triangularis Say, adult, June 16, **Frances McCarty**, Albany N.Y.

Harpalus erraticus Say, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Agonoderus pallipes Fabr., adult., May 21, **F. R. Calkins**, Ossining N.Y.

Pterostichus lucublandus Say, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Cicindela punctulata Fabr., adult, July 6, **Richard Lohrmann**, Herkimer N.Y.

C. repanda Dej., adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

C. vulgaris Say, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

C. generosa Dej., adult, July 6, **Richard Lohrmann**, Herkimer N.Y.

C. 6-guttata Fabr., adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Siphonaptera

Ceratopsyllus serraticeps, cat flea, adult, infesting house, Sep. 14, **Otis Arnold**, Albany N.Y.

Diptera

Mosquito, larvae and adults, July 11, **C. J. Locke**, Ogdensburg N.Y.

Psorophora ciliata Fabr., adult, Aug. 6, **H. C. Weeks**, Sheepshead Bay, Brooklyn N.Y.

Chironomids, adult, Ap. 30, **F. R. Calkins**, Ossining N.Y.

Lasioptera vitis? O. S., June 4, **Francesco Landini**, New York.

Theriopletes affinis adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Tabanus atratus Fabr., mourning horsefly, adult, July 7, **Abraham Knechtel**, Albany N.Y.

Syrphus ribesii Linn., adult, Ap. 30, **F. R. Calkins**, Ossining N.Y.

Stratiomyid, adult, May 25, **C. L. Williams**, Glens Falls N.Y.

Tachinid sp., puparium infesting stalk borer, July 15, **C. L. Williams**, Glens Falls N.Y.

Pollenia rudis Fabr., cluster fly, adults in house, Sep. 1, **K. B. Christman**, Burtonville N.Y.

Phorbia brassicae Bouché, cabbage root maggot, larvae in turnips, Nov. 18, **J. J. Cormot**, Phoenix R.I.

P. ceparum Meigen, onion maggot, grubs on onions, June 19, **Mr VanDerzee**, Kenwood N.Y. Same, Mar. 25, **F. R. Calkins**, Ossining N.Y.

Trypeta longipennis Weid., adult, on Helianthus, July 31, **George S. Graves**, Newport N.Y.

Lepidoptera

Papilio polyxenes Fabr., adult, Feb. 11, **R. K. Colville**, Kenwood N.Y. Same, larva, June 16, **Mrs Humphrey**, Watervliet N.Y.

Pieris oleracea Harr., cabbage butterfly, adult, July 14, **Carl Heiser**, Malone N.Y.

Basilarchia arthemis Dr. banded purple, adult, June 17, **Mrs A. M. A. Jackson**, Camillus N.Y.

Sphecodina abbotii Swains, Oct. 18, **W. C. Hitchcock**, Pittstown N.Y.

Samia cecropia Linn., cecropia moth, adult eggs, June 12, **A. Saunders**, Ridge road, Irondequoit N.Y.

Telea polyphemus Cramer, egg and cocoon, June 6, **C. J. Locke**, Ogdensburg N.Y.

Ctenucha virginica Charp., adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Estigmene acraea Dr. salt marsh caterpillar, adult, June 9, **George S. Graves**, Newport N.Y.

Alypia octomaculata Fabr., 8-spotted forester, larvae on virginia creeper, July 26, **Percy MacG. Allen**, Albany N.Y.

Noctua clandestina Harr., adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Feltia subgothica? Haworth, larva on cabbage, June 25, **C. J. Locke**, Ogdensburg N.Y.

Mamestra picta Harr., zebra caterpillar, larva on strawberry, June 9, **C. L. Williams**, Glens Falls N.Y.

Heliophila pseudargyria Guenée, adults, May 21, **F. R. Calkins**, Ossining N.Y.

Xylina laticinerea? Grote, larva on peach, May 28, **Henry G. Parsons**, Milton N.Y.

Heliothis Armiger Hübn., corn worm, larva on corn, Aug. 25, **Dr M. W. VanDenburg**, Mt Vernon N.Y.

Heterocampa bilineata Pack., larvae on beech, July 12, **E. H. Mairs**, Irvington N.Y.

Notolophus antiqua Linn., larva, June 25, **C. J. Locke**, Ogdensburg N.Y.

Tolype velleda? Stoll, lappet moth, larva on apple, June 13, **Mr Hotchkin**, Binghamton N.Y.

Hydria undulata Linn., on cherry, Aug. 15, **C. R. Pettis**, Saranac Inn N.Y.

Prionoxystus ? robiniae Peck, larvae on beech. Jan. 5, **George S. Graves**, Newport N.Y.

Sanninoidea exitiosa Say, Oct. 18, **W. C. Hitchcock**, Pittstown N.Y.

Sesia acerni Clem., maple sesian, larva on maple, Sep. 18 **W. C. H.**, Hartley Hall Pa.

Evergestis straminalis Hübn., black headed cabbage worm, larvae on turnip, july 22, **George S. Graves**, Newport N.Y.

Hypsopygia costalis Fabr., clover hay worm, larvae, Mar. 16, **J. Mace Smith**, Ithaca N.Y.

Archips rosaceana Harr., adult, June 6, **Reinlein Gasoline Torch Co.**, Mt Vernon N.Y. Same, July 11, **C. J. Locke**, Ogdensburg N.Y. Same, larva on rose, June 25, **C. J. Locke**, Ogdensburg N.Y.

Gelechia acerifella Clem., larva on maple, Aug. 27, **George S. Graves**, Newport N.Y.

Bucculatrix pomifoliella Clem., apple leaf Bucculatrix, cocoons on apple, Nov. 17, **L. L. Woodford**, Berwyn N.Y.

Tineola biselliella Hummel, clothes moth, larva in a mattress, June 25, **Mrs P. N. Nicholas**, Geneva N.Y.

Neuroptera

Psocus venosus Burm., on maple, Aug. 12, **George S. Graves**, Newport N.Y.

Sialis infumata Newm., alder fly, June 6, **C. J. Locke**, Ogdensburg N.Y.

Trichoptera

Mystacides nigra Linn., July 11, **C. J. Locke**, Ogdensburg N.Y.

Plecoptera

Taeniopteryx fasciata Burm., Mar. 25, **F. R. Calkins**, Ossining N.Y.

Pteronarcys regalis Newm., adult, June 6, **C. J. Locke**, Ogdensburg N.Y.

Hemiptera

Canthophorus cinctus Beauv., adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

?Nezara hilaris DeG., nymphs killing asparagus beetle grubs, Sep. 3, **W. F. Greene**, Mt Vernon N.Y.

Leptoptera dolobrata Linn., on wheat, June 15, **J. Jay Barden**, Stanley N.Y. Same, adult, June 25, **C. J. Locke**, Ogdensburg N.Y. Same, July 11, **C. J. Locke**, Ogdensburg N.Y.

Calocoris rapidus Say, adult, June 25, **C. J. Locke**, Ogdensburg N.Y.

Poecilocapsus lineatus Fabr., July 11, **C. J. Locke**, Ogdensburg N.Y.

Capsus ater Linn., adult, June 25, **C. J. Locke**, Ogdensburg N.Y. Same, July 11, **C. J. Locke**, Ogdensburg N.Y.

Acanthia lectularia Linn., bedbug, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Corythuca marmorata Uhler, adults on chrysanthemum, June 1, **Harry Blauvelt**, Coeyman N.Y.

Coriscus subcoleopterus Kirby, adult, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Acholla multispinosa DeG. nymphs on grape, May 25, **F. R. Calkins**, Ossining N.Y.

Cicada tibicen Linn., harvest fly, adult, Aug. 12, **George S. Graves**, Newport N.Y. Same, Aug. 24, **H. B. Taylor**, Albany N.Y.

Ceresa taurina Fitch, tree hopper scars on apple, Ap. 24, **Mr Niles**, Chatham N.Y.

Telemona reclivata? Fitch, July 11, **C. J. Locke**, Ogdensburg N.Y.

Psylla pyricola Riley, pear psylla, all stages on pear, July 26, **Jacob H. Wagar**, Cropseyville N.Y. Same, nymphs on pear, Aug. 17, **Miss M. L. Williams**, Sherburne N.Y. Same, pupa on pear, May 25, **G. F. White**, Preston Hollow N.Y.

Chermes pinicorticis Fitch, pine bark chermes, eggs on white pine, May 2, **C. R. Pettis**, Saranac Inn N.Y.

Pemphigus tessellatus Fitch, larvae and adult on alder, Aug. 29, **C. R. Pettis**, Saranac Inn N.Y.

P. populicaulis Fitch, adult on poplar P. balsamifera, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Hormaphis hamamelidis Fitch, galls on witch hazel, Aug. 12, **George S. Graves**, Newport N.Y.

Schizoneura americana Riley, adults on elm, June 15, **C. J. Locke**, Ogdensburg N.Y.

Lachnus viminalis Fonsc., adult, May 25, **F. R. Calkins**, Ossining N.Y.

Drepanosiphum acerifolii Thos., adults on Acer saccharinum June 26, **George S. Graves**, Newport N.Y.

Aphis gossypii Glover, adults and larvae on tomato, Aug. 6, **C. H. Peck**, Menands N.Y.

?Nectarophora tiliae Monell, basswood louse, eggs on basswood, Nov. 24, **L. L. Woodford**, Berwyn N.Y.

Nectarophora rudbeckiae Fitch, adults on Rudbeckia laciniata, June 25, **G. G. Atwood**, Albany N.Y.

Myzus ribis Linn.? on Ribes aureum, July 8, **W. H. Harrison**, Lebanon Springs N.Y.

M. cerasi Fabr., on cherry, May 25, **F. R. Calkins**, Ossining N.Y. Same, larvae and adult on Prunus pennsylvanica, July 24, **C. R. Pettis**, Saranac Inn N.Y.

Rhopalosiphum solani Thos., tomato louse, all stages, on tomato, June 9, **J. M. Dolph**, Port Jervis N.Y.

Callipterus betulaecolens Fitch, birch leaf aphis on cut *leaved birch*, Aug. 8, **E. P. VanNess**, East Greenbush N.Y.

Lepidosaphes ulmi Linn., appletree bark louse, eggs on lilac, Mar. 17, T. L. M., Staten Island N.Y. Same, adults on willow, May 2, M. T. Richardson, New York.

Chrysomphalus tenebricosus Comst., gloomy scale insect, on maple, Dec. 29, G. W. Herrick, Vicksburg Miss.

Aspidiotus perniciosus Comst., San José scale, adults and young on apple, Nov. 3, Edward V. Cox, New York city. Same, adults and young on peach and plum, Dec. 29, G. W. Herrick, Ellisville Miss. Same, adults on Japanese quince, Feb. 23, Albany N.Y. Same, young adults on Japanese quince, May 7, M. T. Richardson, New York. Same, adults on apple, May 16, A. N. Cloud, Coxsackie N.Y. Same, adults on pear, June 9, George M. Adams, Spencerport N.Y.

A. forbesi Johns., cherry scale insect, adults on cherry, Dec. 29, Glenn W. Herrick, Meridian Miss.

A. ancylus Putn., Putnam's scale, young on apple (fruit) Nov. 10, C. H. Darrow, Geneva N.Y. Same, adult on white birch, Ap. 7, Prof. C. F. Hodge, Clark University, Worcester Mass.

Poliaspis carissae Ckll., adults on carissa, Dec. 22, T. D. A. Cockerell, East Las Vegas N.M.

Phenacaspis natalensis Ckll., adults on mango, Dec. 12, T. D. A. Cockerell, East Las Vegas N.M.

Aulacaspis rosae Bouché, rose scale insect, on blackberry, Nov. 24, L. L. Woodford, Berwyn N.Y.

Chionaspis euonymi Comst., euonymus scale, adults on euonymus, Sep. 19, T. W. Baldwin, Nyack N.Y.

C. lintneri Comst., adults on cornus, Ap. 27, H. C. Peck, Rochester N.Y.

Eulecanium tulipifereae Cook, tuliptree scale insect, adults and young on tulip, Aug. 2, Mrs W. H. Whitaker, Flushing N.Y.

E. prunastri? Fonsc., New York plum scale, adults on pear, June 12, E. L. Mitchell, Clarksville N.Y.

E. nigrofasciatum Perg., black banded lecanium on peach, May 1, G. S. Clarke, Milton N.Y.

E. armeniacum Craw., adults on crimson rambler rose, May 26, Myron S. Wheeler, Berlin Mass.

Coccus hesperidum Linn., on begonia, June 6, C. J. Locke, Ogdensburg N.Y.

Lecanium sp., adult on trumpet vine, June 10, C. E. Eldridge, Leon N.Y.

Pulvinaria innumerabilis Rathv., maple tree scale insect, adult on maple, June 20, M. T. Tyers, Dobbs Ferry N.Y.

Halimococcus lampas Ckll., adults on palm, Dec. 22, T. D. A. Cockerell, East Las Vegas N.M.

Orthoptera

Ceuthophilus maculatus Say, spotted wingless grasshopper, adult, May 15, C. E. Wieting, Cobleskill N.Y.

Thysanura

Achorutes packardi Folsm., adults on peartree bark Ap. 7, A. W. K. Lick, Germantown N.Y.

Arachnida

Micrathena sagittata Walck., adult killing asparagus beetles, Sep. 3, **W. F. Greene**, Mt Vernon N.Y.

Ixodes cruciarius Fitch, tick, Ap. 21, **C. H. North**, Dannemora N.Y.

Dermacentor americanus, the dog or wood tick, adult on dog, July 26, **E. N. Huyck**, Rensselaerville N.Y.

Chernes sanborni Hagen, adult on house fly, Sep. 7, **Dr H. E. Smith**, Norwich N.Y.

Trombidium muscarum Riley, adults on house fly, Sep. 7, **Dr H. E. Smith**, Norwich N.Y.

Phytoptus quadripes Shimer, galls on Acer dasycarpum, July 3, **G. G. Atwood**, Albany N.Y.

Bryobia pratensis Garm., clover mite, eggs on peach, Nov. 17, **L. L. Woodford**, Berwyn N.Y.

Gamasus sp. adult? May 21, **F. R. Calkins**, Ossining N.Y

Myriapoda

Scutigera forceps Raf., house centipede, adults in house, Sep. 22, **Chancey Whitmyre**, Schenectady N.Y.

The following is a small collection, except a few species which have not been determined, of insects kindly contributed by Mr J. R. de la Torre Bueno of New York city, who collected the same in that vicinity.

Cossonus platalea *Say*
Centrinus picumnus *Hbst.*
C. scutellum-album *Say*
Madarus undulatus *Say*
Baris transversa *Say*
Copturus minutus *Lec.*
Conotrachelus seniculus *Lec.*
C. nenuphar *Hbst.*
Gymnetron teter *Fabr.*
Anthonomus signatus *Say*
Otidocephalus chevrolatii *Horn*
Phytonomus nigrirostris *Fabr.*
P. punctatus *Fabr.*
Apion nigrum *Hbst.*
Sitones flavescens *Marsh*
S. hispidulus *Germ.*
Aphrastus taeniatus *Gyll.*
Otiorhynchus ovatus *Linn.*
Phyxelis rigidus *Say*
Attelabus nigripes *Lec.*
Rhynchites bicolor *Fabr.*
Eugnamptus collaris *Fabr.*
Rhipiphorus limbatus *Fabr.*
Mordellistena aspersa *Melsh.*
M. comata *Lec.*
M. trifasciata *Say*
Mordella marginata *Melsh.*
Bruchus musculus *Say*
Cerotoma caminea *Fabr.*
Trichius affinis *Gory.*
Ligyrus gibbosus *DeG.*
Chalepus trachypygus *Burm.*
Anomala lucicola *Fabr.*
Macrodactylus subspinosus *Fabr.*
Chauliognathus pennsylvanicus *DeG.*
Photinus consanguineus *Lec.*
Lucidota atra *Fabr.*
Calopteron reticulatum *Fabr.*
Adalia bipunctata *Linn.*
Coccinella 9-notata *Hbst.*
Hippodamia glacialis *Fabr.*
Silpha surinamensis *Fabr.*
Harpalus caliginosus *Fabr.*
Casnonia pennsylvanica *Linn.*
Cicindela punctulata *Fabr.*

EXPLANATION OF PLATES

PLATE 1

Dorsal view of Eniscopilus arcuatus Felt

PLATE 2

Ophionid wings

1 Ophion ferruginipennis Felt
2 Ophion bifoveolatum Brullé
3 Ophion bilineatum Say
4 Eniscopilus appendiculatus Felt
5 Ophion abnormum Felt
6 Eremotylus macrurus Linn.

PLATE 3

Work of Chrysanthemum lace-bug, Corythuca marmorata Uhler

PLATE 4

Chrysanthemum lace-bug

Corythuca marmorata Uhler

1 Section of leaf showing insertion of eggs below the surface
2 Dorsal spines of stage 1: *a*, arising from cone-shaped base, *b*, directly from the body
3 Lateral abdominal spine of stage 1
4 Dorsal view of nymph in stage 2
5 Dorsal spines of stage 2: *a*, arising from cone-shaped base, *b*, directly from the body
6 Lateral abdominal spine of stage 2
7 Dorsal spines of stage 3: *a*, arising from cone-shaped base, *b*, directly from the body
8 Lateral abdominal spines of stage 3
9 Dorsal view of nymph in stage 4
10 Lateral abdominal spines of stage 4
11 Dorsal spines of stage 4: *a*, arising from cone-shaped base, *b*, directly from the body
12 Lateral abdominal spines of stage 5
13 Antennae in stage 5

Plate 1

Eniscopilus arcuatus

Plate 2

1

2

4

3

5

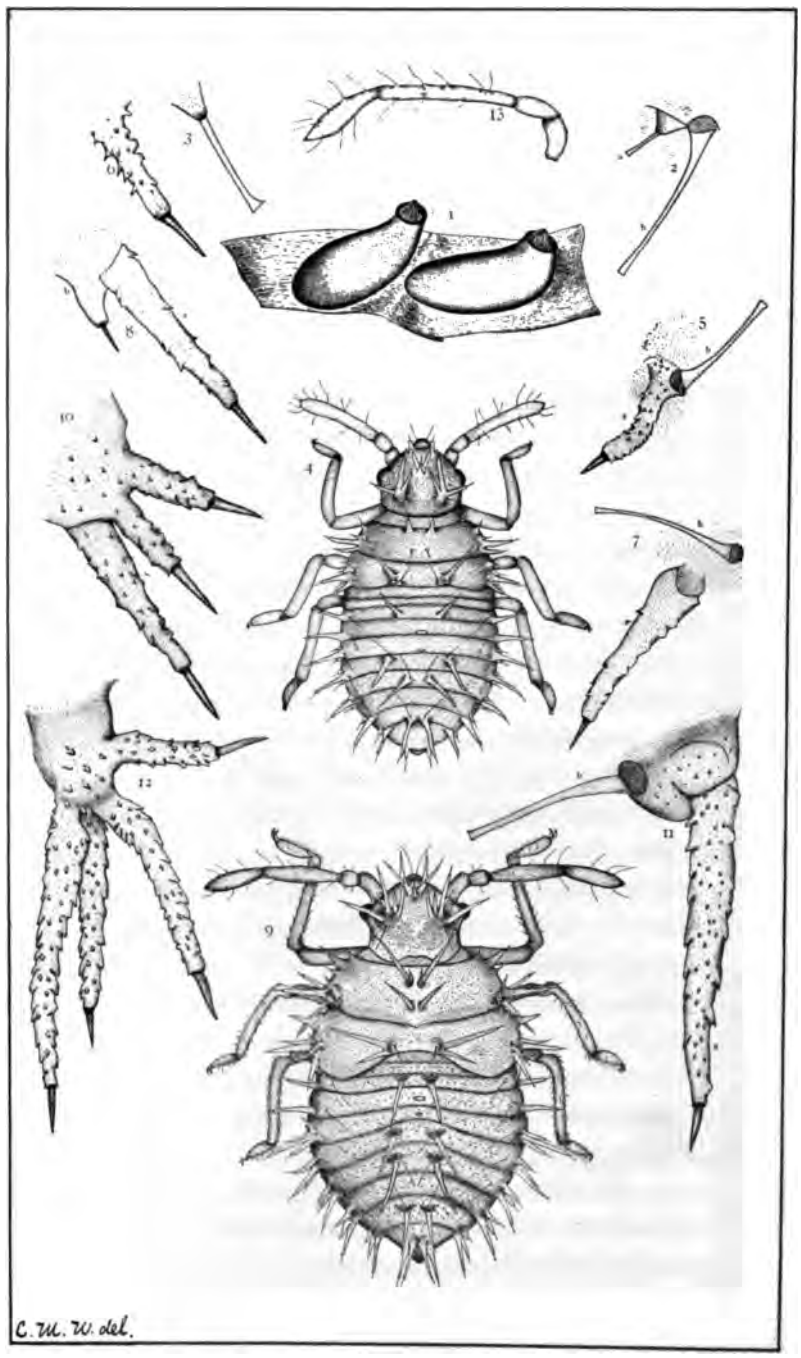
6

Ophionid wings

Plate 3

Work of chrysanthemum lace bug

Plate 4



Chrysanthemum lace bug

INDEX

abnormum, Ophion, 114, 121-22.
acerifolii, Drepanosiphum, 135, 181-82, 192.
aceris, Chaitophorus, 134, 191.
acerni, Sesia, 200.
Acknowledgments, 96.
Adalia bipunctata, 136.
Adirondacks, relation of forest fires to insect attack, 168-69.
Admiral butterflies, red, 184.
agarici, Phora, 193.
agassizii, Halisidota, 106.
Agrilus anxius, 186.
Albany county, summary of voluntary reports from, 174.
albifrons, Symmerista, 118.
Alder, webworm injuring, 183.
Allen Nursery Co., certificate issued to, 95.
Ambrosia beetle, 169, 170, 172.
American economic entomology, literature of, 196.
americana, Apatela, 183.
americana, Malacosoma, *see* Malacosoma americana.
americana, Schizoneura, 181.
Anasa tristis, 175, 177, 180, 185, 189.
? Anthonomus signatus, 187.
antiopa, Euvanessa, 180, 185, 186.
Ants, 184, 198.
anxius, Agrilus, 186.
Apatela americana, 183.
Apatelodes torrefacta, 102.
Aphids, *see* Plant lice.
Aphis, apple, 131-33, 177, 182, 185, 187, 189, 191.
  birch, 136.
  cabbage, 133-34, 176, 180, 182.
  cherry, 133, 175, 177, 185, 186, 188.
  elm, 134-35.
  wooly beech, 136.
Aphis brassicae, 133-34, 176, 180, 182.
  mali, 131-33, 177, 182, 185, 187, 189, 191.
appendiculatus, Eniscopilus, 108, 113.
Appletree, insects injurious to:
  Aphis mali, 177, 182, 185, 189.
  Hyphantria textor, 182, 183, 188.
  Macrodactylus subspinosus, 181.
  Myzus cerasi, 185.
  plant lice, 177, 182, 185, 187.
  Psocus ? venosus, 182.
  Saperda candida, 186.
  Tmetocera ocellana, 183.
Appletree aphis, 131-33, 177, 182, 185, 187, 189, 191.
Appletree bark louse, 195.
Appletree borer, 186.
Appletree tent caterpillar, 138-39, 175, 176, 177, 178, 180, 181, 183, 184, 186, 188, 190, 191, 193.
Appletree worm, yellow-necked, 182.
Apricots, Diabrotica 12-punctata injuring, 138.
Aquatic Chrysomelidae, 199.
Aquatic insects of New York state, 93, 94, 200.
Aquatic Nematocerous Diptera, 199.
Arachnida, contributions of, 220.
arctiae, Eremotylus, *see* Eremotylus arctiae.
arcuatus, Eniscopilus, 108, 112-13.
armicollis, Magdalis, 167.
Army worm, parasite of, 109.
Arsenate of lead, 142, 148, 194, 195, 196, 199.
Arsenical poison, 137.
Ash, mountain, Diplotaxis frondicola injuring, 137.
Ashmead, W. H. acknowledgments to, 97, 105; cited, 104, 105, 106, 111, 116, 120.
asparagi, Crioceris, *see* Crioceris asparagi.
Asparagus beetle, 143, 176, 178-79, 189, 197.
  spotted, 190.

Aspen, Chaitophorus populicola injuring, 136.
Aspidiotus perniciosus, 91, 140-41, 151-66, 192, 193, 194, 195, 196, 197.
Aster, insects injurious to:
Lygus pratensis, 145.
sawfly, 188.
atalanta, Vanessa, 184.
Automeris io, 102, 105.

Balm of Gilead, Pemphigus popularius injuring, 136.
Balsam, insects injurious to:
Chrysobothris pusilla, 172.
Chrysobothris scabripennis, 172.
Polygraphus rufipennis, 169.
Xyloterus lineatus, 172.
barbita, Magdalis, 167.
Barden, J. J., acknowledgments to, 95.
Bark beetle, coarse-writing, 167.
pine, 167.
Bark borers, 167.
Beans, insects injurious to:
Crepidodera cucumeris, 179.
leaf hopper, 182.
plant lice, 183.
Beech, insects injurious to:
Pemphigus imbricator, 135.
plant lice, 191.
Polygraphus rufipennis, 169.
Tremex columba, 171.
Beech, purple, insects injurious to:
Notolophus leucostigma, 191.
Phyllaphis fagi, 136, 191.
Seirodonta bilineata, 191.
Beech aphis, woolly, 136, 191.
Beechtree blight, 135-36.
Beets, Pegomyia vicina injuring, 185.
Beneficial insects, 97-125, 150-51, 194.
betulaecolens, Callipterus, 136.
bifoveolatum, Ophion, 114, 119-20, 121.
bilineata, Seirodonta, 191.
bilineatum, Ophion, *see* Ophion bilineatum.
bimaculata, Oberea, 178, 186.
bipunctata, Adalia, 136.
Birch, insects injurious to:
Agrilus anxius, 186.
Chrysobothris femorata, 171.
Dryocoetes eichhoffi, 171.
plant lice, 182.
Polygraphus rufipennis, 169.
Tremex columba, 171.
Birch, cut-leaved, Callipterus betulaecolens injuring, 136.
Birch aphis, 136.
Birch borer, bronze, 186.
Black flea beetle, 176, 179, 180, 181, 185, 189.
Black knot, 182.
Black lady beetle, little, 150-51.
Black woolly bear, 182.
Blackberry bushes, Oberea bimaculata injuring, 178, 186.
Blauvelt, Egbert, on Corythuca marmorata, 125, 129; on Lygus pratensis, 145.
Blauvelt, Harry, on Corythuca marmorata, 125.
Blennocampa pygmaea, 142.
Blepharoceridae, 199.
Bordeaux mixture, 199.
borealis, Dibolia, 181.
botrana, Polychrosis, 142-43.
Bowman, Thomas & Son, nursery certificate issued to, 95.
Box elder, insects injurious to:
Chaitophorus negundinis, 135, 183.
plant lice, 182.
Box elder plant louse, 135.
brassicae, Aphis, *see* Aphis brassicae.
brassicae, Phorbia, *see* Phorbia brassicae.
Bronze birch borer, 186.
Brown Bros. Co., nursery certificate issued to, 96.
Brown tail moth, 197.
Brown woolly bear, 182.
Bruchus pisorum, 194, 195.
Brullé, Auguste, cited, 103, 111, 120.
Bruner, Lawrence, cited, 101, 104.
brunneus, Rhyncolus, 170.
Bud moth, 177, 178, 183.

Bumble flower beetle, 190.
Buprestid, 6-spotted, 171.
Burdock, plant lice on, 182.
Poecilocapsus lineatus injuring, 179.
Butternut, Datana integerrima injuring, 183.

Cabbage, insects injurious to:
Aphis brassicae, 133, 180.
Phorbia brassicae, 143, 175, 179, 187, 192.
Cabbage aphis, 133-34, 175, 180.
Cabbage butterfly, 175, 176, 178, 180, 182, 183, 186.
Cabbage maggot, 143-44, 175, 179, 192.
Cabbage worm, 178, 187.
black-headed, 182.
calcarata, Saperda, 186.
calligraphus, Tomicus, 167, 193.
Callipterus betulaecolens, 136.
ulmifolii, 134.
Callosamia promethea, 102, 105.
candida, Saperda, 186.
Cankerworms, 179, 183, 184, 191.
Carbolic soap emulsion, 144.
Carbon bisulfid, 145.
cardinalis, Novius, 194.
Carpocapsa pomonella, 139, 183, 187, 191.
Carrot rust fly, 197.
caryae, Halisidota, 118.
Case-bearer, cigar, 179.
Cat flea, 145.
Cattaraugus county, summary of voluntary reports from, 174-76.
Caulfield, F. B., cited, 111.
Cayuga county, summary of voluntary reports from, 176.
Cecidomyia destructor, 178, 179, 183.
cecropia, Samia, 102.
Cedar birds, 186.
ceparum, Phorbia, 144, 187.
Cerambicid, 172.
cerasi, Myzus, *see* Myzus cerasi.
Ceratopsyllus serraticeps, 145-47.
Cetonia, Indian, 176.
Chaitophorus aceris, 134, 191.
negundinis, 135, 181, 183.
populicola, 136.
chalybea, Haltica, 142.
Chambers, V. T., cited, 104.
Charlton Nursery Co., certificate issued to, 95.
Chase Bros. Co., nursery certificate issued to, 96.
Chemung county, summary of voluntary reports from, 176-77.
Cherry aphis, 133, 188.
Cherry borers, 191.
Cherry slug, 186.
Cherrytree, insects injurious to:
cedar birds, 186.
Macrodactylus subspinosus, 178.
Myzus cerasi, 133, 175, 176, 177, 179, 180, 182, 185, 188-89.
Chilocorus similis, 93, 150, 194, 196, 200.
Chinese lady beetle, 93, 150, 194, 200.
Chironomidae, 93.
Chokecherrytrees, Malacosoma ? disstria injuring, 184.
Chrysanthemum lace bug, 125-29.
explanation of plate, 221.
Chrysobothris *sp.*, 170.
femorata, 171.
pusilla, 172.
scabripennis, 171, 172.
Chrysomelidae, aquatic, 199.
chrysorrhoea, Euproctis, 197.
Cigar case-bearer, 179.
Clarkson, Frederick, cited, 104.
Clisiocampa [Malacosoma] americana, 193.
disstria, 193.
Clover, Phytonomus punctatus injuring, 184.
Clover leaf weevil, 184.
Clymonts, T. S., on Polychrosis botrana, 142.
Coccidae, received in exchange, 201, 205-6; available for exchange, 213.
Codling moth, 139, 183, 187, 188, 191.
Coleophora fletcherella, 179.

Coleoptera, taken at Newport N. Y., 197; received in exchange, 202-3; available for exchange, 208-11; contributions of, 213-15.
Coleopterous larvae, 199.
Colias butterfly, 185.
Collections of insects, 94-95; contributions to, 213-20.
coloradensis, Genophion, 123, 124-25.
Colorado potato beetle, *see* Potato beetle.
columba, Tremex, 171.
columbia, Samia, 102.
comes *var.* vitis, Typhlocyba, 192.
Comstock, J. H., acknowledgments to, 97; cited, 101, 104, 125.
concinna, Schizura, 109.
confusor, Monohammus, 169, 193.
Conotrachelus nenuphar, 137, 175, 184.
Cook, M. T., acknowledgments to, 96.
Coquillett, D. W., cited, 104.
Corn, Crepidodera cucumeris injuring, 179.
Correspondence, 92.
Corythuca marmorata, 125-29.
explanation of plate, 221.
costale, Ophion, 114, 123.
Crandall, John R., on Diplotaxis liberta, 137.
Crane fly, 187.
Crepidodera cucumeris, 176, 179, 180-81, 185, 189.
Cresson, E. T., cited, 104, 107, 111, 116, 120, 123.
Crimson rambler rose, lady beetles on, 185.
Crioceris asparagi, 143, 176, 178, 179, 189, 190.
12-punctata, 190.
Cucumber beetle, striped, 177, 179, 180, 181, 185, 186, 187, 190, 191, 194.
Cucumber flea beetle, 176, 179, 180, 181, 185, 189.
Cucumber vines, Diabrotica vittata injuring, 179.
cucumeris, Crepidodera, *see* Crepidodera cucumeris.
Culicidae, 199; received in exchange, 203-4.
Curculio, plum, 137, 175, 184, 197.
Currant aphis, 180, 181.
Currant bushes, insects injurious to:
Myzus ribis, 181.
Poecilocapsus lineatus, 179.
sawfly, 181.
Currant worms, 176, 178, 180, 181, 184, 185-86, 187, 188.
Cutworms, 176, 177, 186, 189.
cyanea, Scutellista, 194.
cynthia, Philosamia, 102.

Daisy, Macrodactylus subspinosus injuring, 181.
Datana integerrima, 149, 183.
ministra, 182.
Davis, G. C., cited, 107, 118, 138.
Davis, K. C., cited, 93, 200.
decem-lineata, Doryphora, *see* Doryphora 10-lineata.
deflorata, Ecpantheria, 105.
Dendroctonus terebans, 193.
destructor, Cecidomyia, 178, 179, 183.
Diabrotica 12-punctata, 137.
harperi, 138.
vittata, 177, 179, 181, 185, 186, 187, 190, 194.
Diacrisia virginica, 105, 115.
Dibolia borealis, 181.
dimidiatus, Phymatodes, 171.
Diplosis pyrivora, 191.
Diplotaxis frondicola, 137.
liberta, 137.
Diptera, received in exchange, 203; available for exchange, 211; contributions of, 215-16.
Diseased and dying trees and insect attack, 167-73.
Diseases and pests, 196.
Disonycha triangularis, 181, 182.
disstria, Malacosoma, *see* Malacosoma disstria.
Dock, insects injuring, 181, 182.
Dog flea, 145.
domestica, Musca, 198.

Doryphora 10-lineata, 175, 176, 177, 178, 180, 184, 185, 187, 190, 192.
Dragon fly, 187.
Drepanosiphum acerifolii, 135, 181-82, 192.
Dryocoetes eichhoffi, 171.
duodecim-punctata, Diabrotica, 137.
Dust and other sprays, 195.
Dutchess county, summary of voluntary reports from, 177-78.

Ecpantheria deflorata, 105.
Eggplant, insects injurious to:
Crepidodera cucumeris, 189.
Diabrotica vittata, 187.
plant lice, 187.
Ehrhorn, E. M., species received from, 201.
eichhoffi, Dryocoetes, 171.
Elm, insects injurious to:
Callipterus ulmifolii, 134.
Disonycha triangularis, 181, 182.
Galerucella luteola, 147, 191.
Hyphantria textor, 188.
plant lice, 182, 187.
Schizoneura americana, 181.
Elm aphis, 134-35.
Elm borer, 167.
Elm flea beetle, 181, 182.
Elm leaf beetle, 91, 134, 147, 174, 189, 190, 191, 195, 196.
Elm snout beetle, 167.
Emmons & Co., nursery certificate issued to, 96.
Eniscopilus, 101, 107.
appendiculatus, 108, 113, 221.
arcuatus, 108, 112-13.
explanation of plate, 221.
purgatus, 98, 100, 107, 108-11, 112.
Entomology, handbook, 193.
Epargyreus tityrus, 118.
Eremotylus, 101.
arctiae, 100, 101, 102, 105-6, 107.
glabratus, 101, 106-7.
macrurus, 97, 99, 100, 101-4, 105, 106, 107, 221.
Erie county, summary of voluntary reports from, 178.
Eriocampoides limacina, 186.
Eulecanium juglandis, 141-42.
tulipiferae, *see* Lecanium [Eulecanium] tulipiferae.
Euphoria inda, 176, 190.
Euproctis chrysorrhoea, 197.
Euvanessa antiopa, 180, 185, 186.
Evans, J. D., cited, 104, 111, 116.
Evergestis stramenalis, 182.
Exchanges, system of, 95, 200-13.
Explanation of plates, 221.

fagi, Phyllaphis, 136, 191.
Fall webworm, 92, 149, 177, 180, 182, 183, 188, 193.
Fallou, cited, 104.
Felt, E. P., Monograph of Genus Saperda, 94.
Feltia gladiaria, 115.
femorata, Chrysobothris, 171.
ferruginipennis, Ophion, 114, 122.
Fidia viticida, 92, 192, 193-94, 195, 196, 197, 198, 199.
First National Nurseries, certificate issued to, 96.
Flea beetle, black or cucumber, 176, 179, 180, 181, 185, 189.
Fleas, 145-47, 195.
Fletcher, James, cited, 111.
fletcherella, Coleophora, 179.
Flies, 175, 198.
black, 199.
Forbes, S. A., cited, 101, 120.
Forest and shade trees, insects injurious to, 94.
Forest fires and insect attack, 168-69, 199.
Forest tent caterpillar, 149, 174, 177, 181, 183, 184, 193.
Forest trees, insects injurious to, 94, 147-49, 192.
frondicola, Diplotaxis, 137.
Fruit growers and truckers, hints to, 197.
Fruit growers association, work and observations in *1902*, 196.
Fruit tree bark beetle, 191, 200.
Fruit tree insects, 137-42.
fuliginipennis, Ophion, 102.
fulvoguttata, Melanophila, 171, 172.
Fyles, T. W., cited, 104.

Galerucella luteola, 91, 134, 147,174, 189, 190, 191, 195, 196.
Gall beetle, gouty, 178, 186.
Garden insects, 143-45.
Garman, H., species received from, 201.
Gartered plume moth, 189.
Genesee county, summary of voluntary reports from, 178-80.
Genophion, 101, 123.
coloradensis, 123, 124-25.
gilletti, 123-24.
Gillette, C. P., species received from, 201.
gilletti, Genophion, 123-24.
glabratus, Eremotylus, 101, 106-7.
gladiaria, Feltia, 115.
Glaea inulta, 115.
Gnathotricus materiarius, 170.
Gooseberries, Pteronus ribesii injuring, 176.
Gouty gall beetle, 178, 186.
Grain beetle, saw-toothed, 145.
Grain pests, 145-47.
Grapeberry moth, 142-43.
Grapevine, insects injurious to, 142-43, 178.
Grapevine leaf hopper, 192.
Grapevine root worm, 92, 94, 192, 193-94, 195, 196, 197, 198, 199.
Grapevine sawfly, 142.
Grasshoppers, 175, 176, 181, 182, 190.
Graves, George S., on Aphis brassicae, 133; on Chaitophorus negundinis, 135; on Drepanosiphum acerfolii, 135; on Pemphigus imbricator, 135; on Callipterus betulaecolens, 136.
Greene county, summary of voluntary reports from, 180.

Haemotobia serrata, 175, 181, 183.
Halisidota agassizii, 106.
caryae, 118.
Haltica chalybea, 142.
harperi, Diabrotica, 138.
Harrington, W. H., cited, 104, 111, 116.
Hart, W. H., experiments in controlling San José scale, 155.
Heliophila unipuncta, 109.
Hemiptera, received in exchange, 205; available for exchange, 212-13; contributions of, 217-19.
Hemlock, insects injurious to:
Melanophila fulvoguttata, 171, 172.
Polygraphus rufipennis, 169.
Xylotrechus undulatus, 172.
Herkimer county, summary of voluntary reports from, 180-83.
Hessian fly, 178, 179, 183, 185.
Horn flies, 175, 181, 183.
Hornets, 183.
Horse-chestnut trees, Notolophus leucostigma injuring, 92.
Horseflies, 175, 183.
House flies, 185, 190, 198.
House pests, 145-47.
Howard, L. O., acknowledgments to, 96, 105, 150; cited, 104, 106, 107, 111, 115, 116, 129, 137.
Hubbard, T. S. Co., nursery certificate issued to, 96.
Huested, P. L., experiments in controlling San José scale, 159.
Hunter, Prof., on number of plant lice, 130.
Hydrocyanic acid gas, 145, 146.
Hymenoptera, received in exchange, 201-2; available for exchange, 207; contributions of, 213.
Hyphantria cunea [textor], 193.
textor, 92, 149, 177, 180, 182, 183, 188.

imbricator, Pemphigus, 135-36.
inda, Euphoria, 176, 190.
Indian Cetonia, 176.
Injurious insects, 125-29; introduced from abroad, 196.
Insect exchange, 95, 200-13.
Insecticides, paper on, 94.
Insecticides and fungicides, 195.
Insecticides and notes, 194.
integerrima, Datana, 149, 183.
inulta, Glaea, 115.
io, Automeris, 102, 105.

isabella, Isia, 102.
Pyrrharctia, 182.
Isia isabella, 102.

Jack, J. G., cited, 101.
Johannsen, Oskar Augustus, cited, 93, 199, 200.
Josselyn, G. S. Co., nursery certificate issued to, 96.
Joutel, L. H., monograph of genus Saperda, 94.
juglandis, Eulecanium, 141-42.
June beetles, 138, 186, 190.

Kellogg, V. L., species received from, 201.
Kerosene emulsion, 132, 141, 144, 166.
Knight & Bostwick, nursery certificate issued to, 96.
Kridelbaugh, cited, 137.

Lacewing flies, 131.
Lachnosterna, 138.
Lady beetle, 131, 185, 190.
Chinese, 93, 150, 194, 200.
little black, 150-51.
spotted, 183.
two spotted, 136.
Lantern slides, added to collection, 92.
Leaf bug, four-lined, 179.
Leaf hopper, 182, 185.
Leaf miner, 185.
Lecanium ? pruinosum, 174.
[Eulecanium] tulipiferae, 199.
Legislation against pests, 194.
Lepidoptera, received in exchange, 204; available for exchange, 211-12; contributions of, 216-17.
Lepidosaphes ulmi, 195.
Leptura subhamata, 171.
leucostigma, Notolophus, *see* Notolophus leucostigma.
Lewis, H. D., on Psylla pyricola, 139.
libatrix, Scoliopteryx, 109.
liberta, Diplotaxis, 137.
Lights, value of for destroying insects, 97-98.
Lilacs, webworm injuring, 183.
Lima beans, Diabrotica vittata injuring, 181.
limacina, Eriocampoides, 186.
Lime, air slacked, 138.
Lime, salt and sulfur mixture, 194, 195, 196.
Lime-sulfur wash, 93, 141, 154-58, 159-60.
lineatus, Poecilocapsus, 179.
Xyloterus, 170, 172.
Lintner, J. A., cited, 100, 104, 106, 116.
London purple, 142, 149.
Looper caterpillar, 174, 194.
Lowe, V. H., experiments, 159; death of, 96.
Lugger, Otto, cited, 109, 111.
luteola, Galerucella, *see* Galerucella luteola.
Lygus pratensis, 144-45.

Mac Gillivray, A. D., cited, 93, 199, 200.
Macrodactylus subspinosus, 138, 175, 178, 181, 185, 186, 189, 198.
Macrurus, Eremotylus, *see* Eremotylus macrurus.
Magdalis armicollis, 167.
barbita, 167.
Maggots in mushrooms, 193.
Malacosoma americana, 138-39, 175, 176, 177, 178, 180, 183, 186, 188, 190, 191, 193.
disstria, 149, 174, 177, 181, 184, 193.
mali, Aphis, *see* Aphis mali.
Mamestra picta, 109, 189-90.
trifolii, 109.
Maple, insects injurious to:
Chaitophorus aceris, 191.
Drepanosiphum acerifolii, 135, 182, 192.
plant lice, 187, 191.
Polygraphus rufipennis, 169.
Psocus ? venosus, 182.
Sesia acerni, 200.
Tremex columba, 171.
Maple, ash-leaf, Chaitophorus negundinis injuring, 181.

Maple, soft, Apatela americana injuring, 183.
Maple aphis, 182.
Mapletree borers, 198.
Marlatt, C. L., cited, 101.
marmorata, Corythuca, 125-29.
materiarius, Gnathotricus, 170.
May beetles, 138, 175, 189.
May fly, 93, 187.
Meat fly, 183.
Mecoptera, available for exchange, 212.
Melanophila fulvoguttata, 171, 172.
Melon vines, Diabrotica vittata injuring, 179.
Midges, net-winged, 199.
ministra, Datana, 182.
miscella, Pentilia, 150-51.
Monohammus confusor, 169, 193.
scutellatus, 169-70.
Morrell, L. L., experiments in controlling San José scale, 155.
Mosquitos, 93, 175, 187, 191, 198, 199.
Mount Hope Nurseries, nursery certificate issued to, 95.
Mountain ash, Diplotaxis frondicola injuring, 137.
Mourning cloak butterflies, 185, 186.
Musca domestica, 198.
Mushrooms, maggots in, 193.
Myriapoda, contributions of, 220.
Mytilaspis pomorum, 195.
Myzus cerasi, 133, 175, 177, 185, 186, 188.
ribis, 180, 181, 186.

Nasturtiums, Pieris rapae injuring, 183.
Needham, James G., cited, 93, 200; report on May flies and midges, 93.
negundinis, Chaitophorus, 135, 181, 183.
Nellis, J. B., & Co., nursery certificate issued to, 96.
nenuphar, Conotrachelus, 137, 175, 184.
Neuroptera, received in exchange, 204; contributions of, 217.
New York entomologic service, 196, 197, 198, 199.
New York plum scale, 141-42.
nigrovarium, Ophion, 114, 121.
nitela, Papaipema, 190.
Norton, Edward, cited, 100, 103, 107, 111, 116, 120.
Norway maple, Chaitophorus aceris injuring, 134.
Notes for the year, 130-51.
Notolophus leucostigma, 91, 115, 147-49, 187, 191.
Novius cardinalis, 194.
Nursery inspection work, 95-96; efficacy, 194.

Oaks, insects injurious to, 94.
Oats, white grubs injuring, 187.
Oberea bimaculata, 178, 186.
ocellana, Tmetocera, 177, 178, 183.
Office work, 92.
Onion, Phorbia ceparum injuring, 144, 187.
Onion maggot, 144, 187.
Onondaga county, summary of voluntary reports from, 183-85.
Ophion, 101, 113.
long-tailed, 97, 101-4.
two-lined, 98, 114.
Ophion abnormum, 114, 121-22, 221.
bifoveolatum, 114, 119-20, 121, 221.
bilineatum, 98, 107, 113, 114-16, 117, 118, 119, 221.
coloradensis, 123.
costale, 114, 123.
ferruginipennis, 114, 122, 221.
fuliginipennis, 102.
glabratum, 106.
nigrovarium, 114, 121.
purgatus, *see* Eniscopilus.
tityri, 98, 113, 116-19, 122, 124.
Ophionid wings, explanation of plate, 221.
Ophionini, value as parasites, 97-98; synopsis of certain genera, 97-125; general habits, 98-99; oviposition and larval habits, 99-100; pupation and final transformations, 100.

Orange county, summary of voluntary reports from, 185-86.
Orthoptera, received in exchange, 207; contributions of, 219.
Osborn, Herbert, cited, 104, 111, 116, 120; species received from, 201.
Oxyptilus periscelidactylus, 189.

Packard, A. S., cited, 100, 103, 109, 111, 116, 119.
Panton, cited, 111.
Papaipema nitela, 190.
Parasites, synopsis of certain genera of the Ophionini, 97-125.
Paris green, 142, 149.
Pea weevil, 194, 195.
Peachtree, Diplotaxis liberta injuring, 137.
Pear midge, 191.
Pear psylla, 139-40, 177, 178, 180, 189, 200.
Pear slug, 186.
Peartree, insects injurious to:
  Eriocampoides limacina, 186.
  Psylla pyricola, 139, 178, 189, 200.
  Scolytus rugulosus, 200.
Peartree, Bosc, green plant louse injuring, 188.
Peas, insects injuring, 185.
Peck, H. C., acknowledgments to, 95.
Pegomyia vicina, 185.
Pemphigus imbricator, 135-36.
  popularius, 136.
Pentilia misella, 150-51.
Peppermint, Poecilocapsus lineatus injuring, 179.
periscelidactylus, Oxyptilus, 189.
Perkins, G. H., cited, 104, 116.
perniciosus, Aspidiotus, *see* Aspidiotus perniciosus.
Perry Nursery Co., nursery certificate issued to, 96.
Petroleum, crude, 153, 193, 195, 196.
Petroleum emulsion, 151-54, 158, 159, 166, 192, 194.
Pettis, C. R., on Pemphigus popularius, 136.
Philosamia cynthia, 102.
phlaeocoptes, Phytoptus, 142.
Phlegethontius 5-maculatus, 176, 187.
Phora agarici, 193.
Phorbia brassicae, 143-44, 175, 179, 187, 192.
  ceparum, 144, 187.
Phyllaphis fagi, 136, 191.
Phymatodes dimidiatus, 171.
Phytonomus punctatus, 184.
Phytoptus phlaeocoptes, 142.
picta, Mamestra, 109, 189-90.
Pieris rapae, 175, 176, 178, 180, 182, 183, 186.
Pigeon tremex, 171.
Pigweed, plant lice on, 182, 183.
Pine, insects injurious to: 94, 193.
  bark borers, 167.
  Monohammus confusor, 169.
  Polygraphus rufipennis, 169.
  Rhyncolus brunneus, 170.
  Tomicus pini, 169.
Pine bark borer, 169.
Pine sawyer, 169.
pini, Tomicus, *see* Tomicus pini.
pisorum, Bruchus, 194, 195.
Plagionotus speciosus, 198.
Plant lice, 91, 130-36, 173, 175, 176, 177, 179, 180, 181, 182, 183, 185, 186, 187, 188, 189, 190, 191, 192, 198, 199.
  green, 184, 188.
Plantains, Crepidodera cucumeris injuring, 181.
Plates, explanation of, 221.
Plecoptera, received in exchange, 207; contributions of, 217.
Plum curculio, 137, 175, 184, 197.
Plum mite, 142.
Plumtree, insects injurious to:
  Aphis mali, 182.
  Diabrotica 12-punctata, 138.
  Eulecanium juglandis, 141.
  Hyphantria textor, 188.
  Phytoptus phlaeocoptes, 142.
  plant lice, 176, 179, 187.
Plumtree, wild, Diplotaxis frondicola injuring, 137.
Poecilocapsus lineatus, 179.
Polychrosis botrana, 142-43.
Polygraphus rufipennis, 169, 170.

polyphemus, Telea, 102, 109.
pomonella, Carpocapsa, *see* Carpocapsa pomonella.
pomorum, Mytilaspis, 195.
Popenoe, E. A., species received from, 201.
Poplar, insects injurious to:
Agrilus anxius, 186.
Euvanessa antiopa, 186.
Saperda calcarata, 186.
Xyleborus *sp.*, 172.
poplar borer, 186.
popularius, Pemphigus, 136.
populicola, Chaitophorus, 136.
Populus balsamiferus, 136.
Potato beetle, 175, 176, 177, 178, 180, 181, 182, 184, 185, 187, 188, 189, 190, 191, 192, 199.
Potato wireworms, 193.
Potatoes, insects injurious to:
Crepidodera cucumeris, 176, 179, 181, 185, 189.
Doryphora 10-lineata, 175, 176, 177, 178, 180, 184, 185, 187, 190, 192.
Potatoes, spray for, 199.
pratensis, Lygus, 144-45.
promethea, Callosamia, 102, 105.
Provancher, *L'Abbé* L., cited, 100, 104, 111, 116, 120.
? pruinosum, Lecanium, 174.
Psila rosae, 197.
Psocus ? venosus, 182.
Psyche, extract from, 112.
Psylla pyricola, 139-40, 177, 180, 189, 200.
Pteronus ribesii, 176, 178, 180, 184, 186, 188.
Publications of entomologist, 93-94, 192-200.
Pumpkins, Diabrotica vittata injuring, 185.
punctatus, Phytonomus, 184.
purgatus, Eniscopilus, *see* Eniscopilus purgatus.
Purple beech, Phyllaphis fagi injuring, 136.
pusilla, Chrysobothris, 172.
pygmaea, Blennocampa, 142.
pyricola, Psylla, *see* Psylla pyricola.
pyrivora, Diplosis, 191.
Pyrrharctia isabella, 182.

Quinces, plant lice injuring, 132, 179.
quinquemaculatus, Phlegethontius, 176, 187.

rapae, Pieris, *see* Pieris rapae.
Red admiral butterflies, 184.
Red spider, 189.
Remedies and preventives for:
appletree plant louse, 132.
asparagus beetle, 197.
cabbage maggot, 144.
Chaitophorus aceris, 134.
cherry plant louse, 133.
chrysanthemum lace bug, 129.
Diplotaxis liberta, 138.
fall webworm, 149.
fleas, 146, 195.
fruit tree bark beetle, 200.
grapeberry moth, 142.
grapevine root worm, 92, 194, 197, 198, 199.
grapevine sawfly, 142.
maggots in mushrooms, 193.
New York plum scale, 141.
pear psylla, 140.
plant lice, 132, 133, 134, 190, 198, 199.
plum curculio, 137, 197.
potato beetles, 199.
San José scale, 93, 151-66, 192, 193, 194, 196, 197.
saw-toothed grain beetle, 145.
Sesia acerni, 200.
steely flea beetle, 142.
tarnished plant bug, 145.
tussock moth, white marked, 148-49.
Remedies and preventives for insect depredations:
arsenate of lead, 142, 148, 194, 195, 196, 199.
arsenical poison, 137.
bands of tar or cotton, 148.
bordeaux mixture, 199.
carbolic soap emulsion, 144.

Remedies etc. (*continued*)
carbon bisulfid, 145.
dust and other sprays, 195.
hydrocyanic acid gas, 145, 146.
kerosene emulsion, 132, 141, 144, 166.
lime, air slacked, 138.
lime, salt and sulfur, 194, 195, 196.
lime-sulfur wash, 141, 154-58, 159-66.
london purple, 142, 149.
paris green, 142, 149.
petroleum, crude, 153, 193, 195, 196.
petroleum emulsion, 151-54, 158, 159, 166, 192, 194.
tobacco water, 132.
whale oil soap, 129, 132, 134, 140, 141, 145, 158, 166, 190, 192, 194, 195, 196.
wood ashes, 138.
Report of state entomologist, 197.
Rhopalosiphum solani, 185.
Rhyncolus brunneus, 170.
ribesii, Pteronus, *see* Pteronus ribesii.
ribis, Myzus, 180, 181, 186.
Riley, C. V., cited, 100, 101, 102, 103-4, 106, 107, 111, 116, 120, 137.
Rockland county, summary of voluntary reports from, 186.
Roesch, Lewis, nursery certificate issued to, 96.
Rogers Nursery, certificate issued to, 96.
rosae, Psila, 197.
Rose, J. F., on plant lice, 132; on Aphis brassicae, 133.
Rose beetle, 138, 175, 178, 181, 185, 186, 189, 198.
Rose slugs, 187.
Rosebushes, insects injurious to:
Diplotaxis frondicola, 137.
leaf hoppers, 185.
Macrodactylus subspinosus, 175, 181, 185.
Myzus cerasi, 185.
plant lice, 182, 184, 185, 189, 190.
Rosebushes etc. (*continued*)
Tetranychus telarius, 189.
rufipennis, Polygraphus, 169, 170.
rugulosus, Scolytus, 191.

Sage, Poecilocapsus lineatus injuring, 179.
St Lawrence county, summary of voluntary reports from, 186-88.
Samia cecropia, 102.
columbia, 102.
San José Scale, 91, 93, 140-41, 150, 151-66, 192, 193, 194, 195, 196, 197.
Sanborn, F. G., cited, 103, 116.
Sanders, J. G., species received from, 201.
Saperda, monograph of genus, 94.
calcarata, 186.
candida, 186.
tridentata, 167.
Saratoga county, summary of voluntary reports from, 188.
Saunders, William, cited, 104, 116.
Saw-toothed grain beetle, 145.
Sawfly, 181, 188.
Say, Thomas, cited, 107, 111, 116.
scabripennis, Chrysobothris, 171, 172.
Scale insects, 194; determinations of, 92; soft, 174.
Schenectady county, summary of voluntary reports from, 188.
Schizoneura americana, 181.
Schizura concinna, 109.
unicornis, 109.
Schuyler county, summary of voluntary reports from, 188.
Sciara *sp.*, 193.
Scolioptéryx libatrix, 109.
Scolytus rugulosus, 191, 200.
Scudder, S. H., cited, 103, 116, 119.
scutellatus, Monohammus, 169-70.
Scutellista cyanea, 194.
Scirodonta bilineata, 191.
serrata, Haemotobia, 175, 181, 183.
Sesia acerni, 200.
Shad flies, 187.
Shade tree ratings, 195.

Shade trees, injurious insects, 94, 147-49.
Sheeren Wholesale Nurseries, certificates issued to, 95-96.
Sialididae, 200.
signatus, ?Anthonomus, 187.
Silvanus surinamensis, 145.
similis, Chilocorus, *see* Chilocorus similis.
Simulilidae, 199.
Siphonaptera, contributions of, 215.
Sirrine, F. A., on Phorbia brassicae, 144.
Slosson, A. T., cited, 120.
Smith, J. B., cited, 101, 103, 104, 107, 111, 116, 120; acknowledgments to, 113.
Snow, F. H., species received from, 201.
solani, Rhopalosiphum, 185.
Special investigations, 92-93.
speciosus, Plagionotus, 198.
Spiny elm caterpillar, 186.
Spittle insects, 181, 185.
Spraying, 195. *See also* Remedies.
Spruce, insects injurious to:
Chrysobothris *sp.*, 170.
Chrysobothris scabripennis, 171.
Gnathotricus materiarius, 170.
Phymatodes dimidiatus, 171.
Polygraphus rufipennis, 169, 170.
Xyloterus lineatus, 170.
Xylotrechus undulatus, 171.
Spruce bark beetle, 169, 170.
Squash bug, 175, 177, 180, 185, 189.
Squash vines, insects injurious to:
Anasa tristis, 175, 177, 180, 189.
Diabrotica vittata, 179.
Stalk borer, 190.
Steely flea beetle, 142.
stramenalis, Evergestis, 182.
Strawberry plants, insects injurious to:
Diabrotica harperi, 138.
Mamestra picta, 190.
Strawberry weevil, 187.
Stuart, C. W., & Co., nursery certificate issued to, 96.
subhamata, Leptura, 171.
subspinosus, Macrodactylus, *see* Macrodactylus subspinosus.
Summer washes, 159-66.
Sunflowers, plant lice injuring, 183.
surinamensis, Silvanus, 145.
Sweet, George A., Nursery Co., certificate issued to, 96.
Symmerista albifrons, 118.
Syrphus flies, 131.

Tamarack, insects injurious to:
Leptura subhamata, 171.
Polygraphus rufipennis, 169.
Tomicus pini, 171.
Tarnished plant bug, 144-45.
Taylor, H. S., & Co., nursery certificate issued to, 95.
telarius, Tetranychus, 189.
Telea polyphemus, 102, 109.
terebans, Dendroctonus, 193.
Tetranychus telarius, 189.
textor, Hyphantria, *see* Hyphantria textor.
Thorn apple, Macrodactylus subspinosus injuring, 181.
Thysanura, contributions of, 219.
Timothy, Pyrrharctia isabella injuring, 183.
Tingis arcuata, 128.
tityri, Ophion, *see* Ophion tityri.
tityrus, Epargyreus, 118.
Tmetocera ocellana, 177, 178, 183.
Tobacco water, 132.
Tobacco worm, 176.
Tomato worm, 187.
Tomatoes, insects injurious to:
Crepidodera cucumeris, 179, 181, 185, 189.
Rhopalosiphum solani, 185.
Tomicus calligraphus, 167, 193.
pini, 167, 169, 171, 193.
torrefacta, Apatelodes, 102.
Trap lantern records, 108, 114, 117, 120.
Tremex columba, 171.
Triangularis, Disonycha, 181, 182.
Trichoptera, available for exchange, 212; contributions of, 217.
tridentata, Saperda, 167.
trifolii, Mamestra, 109.

tristis, Anasa, *see* Anasa tristis.
Trouvelet, cited, 99, 103.
Trumpet vine, Lecanium ? pruinosum injuring, 174.
Tulip tree scale, 199.
Turnips, insects injurious to:
Aphis brassicae, 133, 182.
Evergestis stramenalis, 182.
Phorbia brassicae, 192.
Tussock moth, white-marked, 91, 147-49, 187, 191.
Typhlocyba comes *var.* vitis, 192.

Uhler, P. H., cited, 129.
ulmi, Lepidosaphes, 195.
ulmifolii, Callipterus, 134.
Ulster county, summary of voluntary reports from, 188-89.
undulatus, Xylotrechus, 171, 172.
unicornis, Schizura, 109.
unipuncta, Heliophila, 109.

Van Alstyne, Edward, experiments in controlling San José scale, 155.
Van Duzee, E. P., acknowledgments to, 96.
Vanessa atalanta, 184.
? venosus, Psocus, 182.
vicina, Pegomyia, 185.
virginica, Diacrisia, 105, 115.
viticida, Fidia, *see* Fidia viticida.
vittata, Diabrotica, *see* Diabrotica vittata.
Voluntary entomologic service of New York state, 96, 173-92.

Walker, C. M., determinations of scale insects, 92; experiments with summer washes, 93; experiments with lime-sulfur wash, 160-66; arrangement of collections, 94; nursery inspection work, 95.
Walnut trees, black, Datana integerrima injuring, 149.
Walnut worm, 149.
Warren county, summary of voluntary reports from, 189-90.
Waterhouse, cited, 104.
Wayne county, summary of voluntary reports from, 190.
Webster, F. M., cited, 101, 111.
Webworm, fall, 92, 149, 177, 180, 182, 183, 188, 193.
Weed, C. M., cited, 102, 104.
Westchester county, summary of voluntary reports from, 190-91.
Western New York Nursery Co., nursery certificate issued to, 95.
Whale oil soap, 129, 132, 134, 140, 141, 145, 158, 166, 190, 192, 194, 195, 196.
Wheat, Diabrotica harperi injuring, 138.
White grubs, 187.
Williams, C. L., on Crioceris asparagi, 143.
Williston, S. W., determinations by, 201.
Wood, A. L., nursery certificate issued to, 95.
Wood, Albert, on Psylla pyricola, 140.
Wood ashes, 138.
Woolly bear, black, 182.
brown, 182.
Woolly beech aphis, 136, 191.
Worthington, C. E., cited, 104.
Wyoming county, summary of voluntary reports from, 191-92.

Xyleborus *sp.*, 172.
Xyloterus lineatus, 170, 172.
Xylotrechus undulatus, 171, 172.

Young, D. B., investigations on mosquitos, 93; work on forest insects, 94; work on collections, 94-95; on Drepanosiphum acerifolii, 135; on Callipterus betulaecolens, 136; investigations on forest fires and insect attack, 168-69.

Zebra caterpillar, 109, 189.

4 Peck, C: H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. *75c.*
This includes revised descriptions and illustrations of fungi reported in the 49th, 51st and 52d reports of the state botanist.

5 Clarke, J: M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. 196p. 21pl. July 1903. *$1.50, cloth.*

6 —— Naples Fauna in Western New York. 268p. 26pl. map. *$2. cloth.*

7 Ruedemann, Rudolf. Graptolites of New York. Pt1 Graptolites of the Lower Beds. *In press.*

Felt, E. P. Insects Affecting Park and Woodland Trees. *In preparation.*

Natural history of New York. 30v. il. pl. maps. Q. Albany 1842-94.

DIVISION 1 ZOOLOGY. De Kay, James E. Zoology of New York; or, The New York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New York with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations. 5v. il. pl. maps. sq. Q. Albany 1842-44. *Out of print.*
Historical introduction to the series by Gov. W: H. Seward. 178p.

v. 1 pt1 Mammalia. 13+146p. 33pl. 1842.
300 copies with hand-colored plates.

v. 2 pt2 Birds. 12+380p. 141pl. 1844.
Colored plates.

v. 3 pt3 Reptiles and Amphibia. 7+98p. pt4 Fishes. 15+415p. 1842.
pt3-4 bound together.

v. 4 Plates to accompany v. 3. Reptiles and Amphibia 23pl. Fishes 79pl. 1842.
300 copies with hand-colored plates

v. 5 pt5 Mollusca. 4+271p. 40pl. pt6 Crustacea. 70p. 13pl. 1843-44.
Hand-colored plates: pt5-6 bound together.

DIVISION 2 BOTANY. Torrey, John. Flora of the State of New York; comprising full descriptions of all the indigenous and naturalized plants hitherto discovered in the State, with remarks on their economical and medical properties. 2v. il. pl. sq. Q. Albany 1843. *Out of print.*

v. 1 Flora of the State of New York. 12+484p. 72pl. 1843.
300 copies with hand-colored plates.

v. 2 Flora of the State of New York. 572p. 89pl. 1843.
300 copies with hand-colored plates.

DIVISION 3 MINERALOGY. Beck, Lewis C. Mineralogy of New York; comprising detailed descriptions of the minerals hitherto found in the State of New York, and notices of their uses in the arts and agriculture. il. pl. sq. Q. Albany 1842. *Out of print.*

v. 1 pt1 Economical Mineralogy. pt2 Descriptive Mineralogy. 24+536p. 1842.
8 plates additional to those printed as part of the text.

DIVISION 4 GEOLOGY. Mather, W: W.; Emmons, Ebenezer; Vanuxem, Lardner & Hall, James. Geology of New York. 4v. il. pl. sq. Q. Albany 1842-43. *Out of print.*

v. 1 pt1 Mather, W: W. First Geological District. 37+653p. 46pl. 1843.

v. 2 pt2 Emmons, Ebenezer. Second Geological District. 10+437p. 17pl. 1842.

v. 3 pt3 Vanuxem, Lardner. Third Geological District. 306p. 1842.

v. 4 pt4 Hall, James. Fourth Geological District. 22+683p. 19pl. map. 1843.

DIVISION 5 AGRICULTURE. Emmons, Ebenezer. Agriculture of New York; comprising an account of the classification, composition and distribution of the soils and rocks and the natural waters of the different geological formations, together with a condensed view of the meteorology and agricultural productions of the State. 5v. il. pl. sq. Q. Albany 1846-54. *Out of print.*

v. 1 Soils of the State, their Composition and Distribution. 11+371p. 21pl. 1846.

v. 2 Analysis of Soils, Plants, Cereals, etc. 8+343+46p. 42pl. 1849.
With hand-colored plates.

v. 3 Fruits, etc. 8+340p. 1851.

v. 4 Plates to accompany v. 3. 95pl. 1851.
Hand-colored

v. 5 Insects Injurious to Agriculture. 8+272p. 50pl. 1854.
With hand-colored plates.

DIVISION 6 PALEONTOLOGY. Hall, James. Palaeontology of New York. 8v. il. pl. sq. Q. Albany 1847-94. *Bound in cloth.*

v. 1 Organic Remains of the Lower Division of the New York System. 23+338p. 99pl. 1847. *Out of print.*

v. 2 Organic Remains of Lower Middle Division of the New York System. 8+362p. 104pl. 1852. *Out of print.*

v. 3 Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone. pt1, text. 12+532p. 1859. [*$3.50*]

—— pt2, 143pl. 1861. [*$2.50*]

v. 4 Fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 11+1+428p. 99pl. 1867. *$2.50.*

v. 5 pt1 Lamellibranchiata 1. Monomyaria of the Upper Helderberg, Hamilton and Chemung Groups. 18+268p. 45pl. 1884. *$2.50.*

—— —— Lamellibranchiata 2. Dimyaria of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 62+293p. 51pl. 1885. *$2.50.*

—— pt2 Gasteropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 2v. 1879. v. 1, text. 15+492p. v. 2, 120pl. *$2.50 for 2 v.*

v. 6 Corals and Bryozoa of the Lower and Upper Helderberg and Hamilton Groups. 24+298p. 67pl. 1887. *$2.50.*

v. 7 Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups. 64+236p. 46pl. 1888. Cont. supplement to v. 5, pt2. Pteropoda, Cephalopoda and Annelida. 42p. 18pl. 1888. *$2.50.*

v. 8 pt1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16+367p. 44pl. 1892. *$2.50.*

—— pt2 Paleozoic Brachiopoda. 16+394p. 84pl. 1894. *$2.50.*

Catalogue of the Cabinet of Natural History of the State of New York and of the Historical and Antiquarian Collection annexed thereto. 242p. O. 1853.

Handbooks 1893-date. 7½x12½ cm.
In quantities, 1 cent for each 16 pages or less. Single copies postpaid as below.

H5 New York State Museum. 52p. il. *4c.*
Outlines history and work of the museum with list of staff 1902.

H13 Paleontology. 12p. *2c.*
Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology; Relation to stratigraphy; History of paleontology in New York.

H15 Guide to Excursions in the Fossiliferous Rocks of New York. 124p. *8c.*
Itineraries of 32 trips covering nearly the entire series of Paleozoic rocks, prepared specially for the use of teachers and students desiring to acquaint themselves more intimately with the classic rocks of this State.

H16 Entomology. 16p. *2c.*

H17 Economic Geology. 44p. *4c.*

H18 Insecticides and Fungicides. 20p. *3c.*

H19 Classification of New York Series of Geologic Formations. 32p. *3c.*

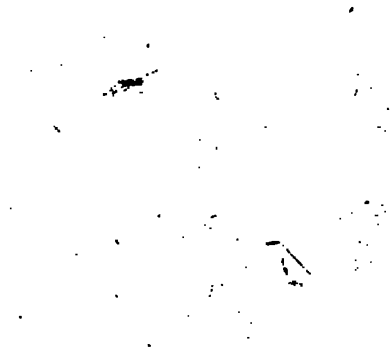
Maps. Merrill, F: J. H. Economic and Geologic Map of the State of New York; issued as part of Museum bulletin 15 and the 48th Museum Report, v. 1. 59x67 cm. 1894. Scale 14 miles to 1 inch. *Separate edition out of print.*

—— Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas form $3; mounted on rollers $5. Lower Hudson sheet 60c.*
The lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam, Westchester, New York, Richmond, Kings, Queens and Nassau counties, and parts of Sullivan, Ulster and Suffolk counties; also northeastern New Jersey and part of western Connecticut.

—— Map of New York showing the Surface Configuration and Water Sheds. 1901. Scale 12 miles to 1 inch. *15c.*

Clarke, J: M. & Luther, D. D. Geologic map of Canandaigua and Naples *Quadrangles.* 1904. *20c.*
Issued as part of Paleontology 7.

polyphemus, Telea, 102, 109.
pomonella, Carpocapsa, *see* Carpocapsa pomonella.
pomorum, Mytilaspis, 195.
Popenoe, E. A., species received from, 201.
Poplar, insects injurious to:
Agrilus anxius,186.
Euvanessa antiopa, 186.
Saperda calcarata, 186.
Xyleborus *sp.*, 172.
poplar borer, 186.
popularius, Pemphigus, 136.
populicola, Chaitophorus, 136.
Populus balsamiferus, 136.
Potato beetle, 175, 176, 177, 178, 180, 181, 182, 184, 185, 187, 188, 189, 190, 191, 192, 199.
Potato wireworms, 193.
Potatoes, insects injurious to:
Crepidodera cucumeris, 176, 179, 181, 185, 189.
Doryphora 10-lineata, 175, 176, 177, 178, 180, 184, 185, 187, 190, 192.
Potatoes, spray for, 199.
pratensis, Lygus, 144-45.
promethea, Callosamia, 102, 105.
Provancher, *L'Abbé* L., cited, 100, 104, 111, 116, 120.
? pruinosum, Lecanium, 174.
Psila rosae, 197.
Psocus ? venosus, 182.
Psyche, extract from, 112.
Psylla pyricola, 139-40, 177, 180, 189, 200.
Pteronus ribesii, 176, 178, 180, 184, 186, 188.
Publications of entomologist, 93-94, 192-200.
Pumpkins, Diabrotica vittata injuring, 185.
punctatus, Phytonomus, 184.
purgatus, Eniscopilus, *see* Eniscopilus purgatus.
Purple beech, Phyllaphis fagi injuring, 136.
pusilla, Chrysobothris, 172.
pygmaea, Blennocampa, 142.
pyricola, Psylla, *see* Psylla pyricola.
pyrivora, Diplosis, 191.
Pyrrharctia isabella, 182.

Quinces, plant lice injuring, 132, 179.
quinquemaculatus, Phlegethontius, 176, 187.

rapae, Pieris, *see* Pieris rapae.
Red admiral butterflies, 184.
Red spider, 189.
Remedies and preventives for:
appletree plant louse, 132.
asparagus beetle, 197.
cabbage maggot, 144.
Chaitophorus aceris, 134.
cherry plant louse, 133.
chrysanthemum lace bug, 129.
Diplotaxis liberta, 138.
fall webworm, 149.
fleas, 146, 195.
fruit tree bark beetle, 200.
grapeberry moth, 142.
grapevine root worm, 92, 194, 197, 198, 199.
grapevine sawfly, 142.
maggots in mushrooms, 193.
New York plum scale, 141.
pear psylla, 140.
plant lice, 132, 133, 134, 190, 198, 199.
plum curculio, 137, 197.
potato beetles, 199.
San José scale, 93, 151-66, 192, 193, 194, 196, 197.
saw-toothed grain beetle, 145.
Sesia acerni, 200.
steely flea beetle, 142.
tarnished plant bug, 145.
tussock moth, white marked, 148-49.
Remedies and preventives for insect depredations:
arsenate of lead, 142, 148, 194, 195, 196, 199.
arsenical poison, 137.
bands of tar or cotton, 148.
bordeaux mixture, 199.
carbolic soap emulsion, 144.